

LIFE OF JAMES HALL



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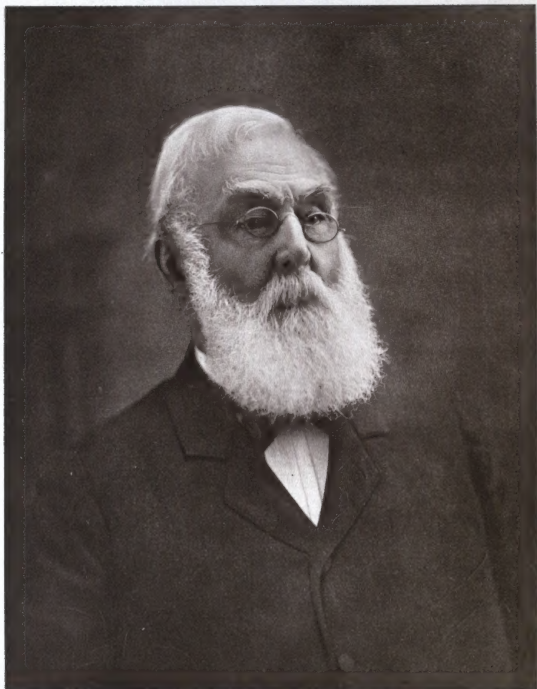
W.S.W. KEW

JAMES HALL

OF ALBANY

GEOLOGIST AND PALAEONTOLOGIST

1811-1898



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BY

JOHN M. CLARKE

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PREFATORY WORD

The official scientific career of James Hall extended over a period of nearly sixty-three years. During this entire stretch of time he served the same State without interruption. He was a youth of 25 when he entered this service, an old man of 87 when this service ceased. It is probable that this record of official scientific activity has never been equaled in duration. As it was long in time, so it was great in fruitfulness and admirable in devotion. During his life he touched the rapidly developing science of geology in many of its phases; in nearly all through the period of its romantic adventures. His publications are spread through a score of quarto volumes and several hundred pamphlets, but the intimate story of his life has never been written. The present volume is the effort to portray the man as he was; the influences that guided him and that he imparted; the work he did and the manner of doing it; the friendships he made and the esteem he won. It has been prepared by one who was closely associated with him during his last twelve years.

This work has reached unexpected size, but the interests of this single life to American geology and to the public service, its lessons of singleness of purpose and loyalty, seem to justify the picture as here presented.

JOHN M. CLARKE

CHAPTER I

PARENTAGE, BOYHOOD AND SCHOOLDAYS AT HINGHAM

Hingham; its location and settlement—Arrival of James Hall, Sr., from England—A woollen-weaver—General Lincoln's mill—The Old Ship Church—Death of the parents—The "haunts of my childhood"—Boy interest in Nature—Poverty at home—Hingham schools and schoolmasters—Increase N. Smith—Boyhood friendships and letters—Charles S. Kendall—Burning of Doctor Beecher's church—The octogenarians—Hall's lack of interest in the rocks—Boston influences—Martin Gay—The Linnaean Society—The Boston Society of Natural History—Amos Binney, George B. Emerson, Augustus A. Gould, D. Humphreys Storer—Natural History of Massachusetts.

IN the early years of the last century the town of Hingham, Massachusetts, a cradle of distinguished Americans, was devoting itself to the practise of a liberal theology and, among other things, to the manufacture of woolens, satinets and silk umbrellas. Situated on the south shore of Boston Bay, this venerable post-town dated its first organized settlement back to the year 1633, and its "assessment" as a plantation to 1635, when the Reverend Peter Hobart¹ and twenty-nine others

¹ Peter Hobart's daughter Rebecca married, at Hingham, 1679, Daniel, son of Captain John Mason; thence the writer of these pages.

arrived out from Old Hingham, came ashore in the "Cove," took up their lots and built their church. The village had grown to be one of mills which ground and sawed and wove for the countryside and made twenty thousand silk umbrellas a year; and all honestly done, for it has been set down in the history of the town that some of these umbrellas were still in service after seventy years of use! Prettily set on its own harbor of the bay where the tidal inlets of the waterside were made to serve some of its mills, and indeed do yet; its rounded and weathered granite knobs and its occasional gravelly drumlins command the islet-dotted expanse of the harbor and, out beyond, the broader waters bounded by the long arm of Nantasket Beach. "Its form," said Johnson in his *Wonder Working Providence* (1654), referring to the coast of Hingham, "is somewhat intricate to describe by reason of the sea's washing crookes where it beats upon a mouldering shore." We find it so, for today its "crookes" have been but lightly straightened out by human control of the sea's invasions, the "mouldering shore" remains, and the salt marsh spreads wide along the tide streams and among the rocky knolls. Away back from the shore lie the Glad Tidings Plain, the Liberty Plain, and out of them rise those "Hills of Hingham," whose emotions and philosophy have

been so happily portrayed by a later lover of the place.²

To Hingham village sometime in the early 1800s, came James Hall, the father of our geologist, bringing with him his young wife. There seems to be a tradition in the family that in his England home this young man had been destined by an austere parent for the army, notwithstanding the fact that two of his brothers had already given their lives in the wars with Napoleon. Restive under these paternal demands and determined to make his own career, he got together, it is said, what little of substance he could command and set sail, leaving the old England to try out his fortune in the new. Whether or not he really carried the intention to remain, his stars did, for on shipboard during the long voyage came the oft repeated romance of the sea,—he fell in love with a maiden of his own land, Susanna Dourdain, and they were married soon after the arrival of their ship in Boston.

Nineteen years old, in a strange country, knowing no man, without capital or a trade and with a wife, the young fellow stared the struggle for existence solemnly in the face. By a strange chance, somewhere along the coast, perhaps at Hingham whither he may have wandered, the young adventurer rescued a drowning girl, and this Puritan maiden proved to be the daughter of

² Dallas Lore Sharp; "The Hills of Hingham", 1916

a Mr. Hapgood, owner of the woolen mills in Hingham. The effective incident led quite naturally to an acquaintance with this father and eventually to young Hall's employment in the Hapgood mill on the Weir river, and here he remained till his death in 1836, at the early age of forty-five.

Thus the story which has been perpetuated in the family; but like many family tales, it needs correction to conform with the records of the settlement.

Major-General Benjamin Lincoln, the Revolution and Shays's Rebellion being over and his service as President Washington's Secretary of War closed, returned to his home at Hingham and interested himself in the establishment of a flouring mill on the Weir river east of the village. After the death of General Lincoln in 1810, this was converted into a woolen mill and was conducted by the General's son. James Hall Senior had served his apprenticeship in England as a woolen-weaver and it seems likely that he had come out to Hingham in response to a request for such service as he could give. In 1812, Mr. Hall was superintendent of the Lincoln mill, a position he could not have held without expert training, and was turning out satinets and cassimeres in such quantity that "business was said to be prosperous." In 1816 the mill was sold to Henry Hapgood, Mr. Hall remaining as its superintendent.

During the first years of their life in Hingham, James and Susanna had made their home on the riverside where the mill stood, and there about a year after their marriage their eldest child, *James*, the subject of this record, was born, *September 12, 1811*. Other children came in due time, Susanna and Hannah, Anna and William, and as the family grew and the business became more profitable, the home was moved to South street in the heart of the village. I never heard Professor Hall speak of his father. In my time memories of him belonged to a distant childhood to which he seldom referred. But the recollections of one of his contemporaries are that he was a man of rather scholarly disposition, a buyer and reader of somewhat learned books, as his slender means afforded. A growing family and the necessity of establishing his position in the community by the maintenance of a home and by becoming a pew-owner in the venerable First Parish Meeting House,³ must have helped to sharpen the family resources to a narrow angle. After a short but active life Mr. Hall died, and in the absence of other record his epitaph in the Hingham Burying Ground suffices: *The memory of his virtues still lives.*

³ The ancient Meeting House, built in 1681 and still vibrant with the centuries, is the "Old Ship Church," so called because its axe-hewn beams, yet visible, are said to have been the timbers of a dismantled ship.

Of the mother, the English girl who had pledged her fortunes to those of her fellow traveler before either had seen the shores of their hopes, we also know very little. I think she must have been a gentle and faithful counselor, for the son's attachment to her was deep and tender, sacred as a man's love for his mother is wont to be, the more even as the years grow old. Though she was never a subject of conversation in our interviews, I shall not forget his touching tribute to her in a letter he wrote at the death of another mother. He was then eighty, and "even today," he said, "in my troubles I feel as if I must take them to her." Mrs. Hall lived twenty-three years after her husband, dying in 1859 at the age of seventy. She maintained her home at Hingham whither the son journeyed by every opportunity, and she sometimes went with him into the fields of his early geological work.

We shall be somewhat at loss in estimating the effect of home influences in expanding the profoundly instinctive love of nature in the young Hall, but it is not difficult to conceive how his other surroundings gave play to this love. Along the rocky knolls and islets of the Bay a heavy tidal ebb uncovered the rich sea life clinging to the stony bottom or half buried in the tidal muds. There were tidal inlets running up from the bay shore into a meandering river, and all about the settle-

ment the projecting granite hills, the woods, the clearings, the salt marshes and the broad terrace plains cried loudly to the boy. And their echo lasted long, for in one of his published letters, written when he was eighty-five years old, he speaks of the "haunts of my childhood where I had collected shells upon the sea beach and flowers in the swamps and woods; flowers for which in that former time no names were known nor means of learning how to know them."⁴

There is abundance of incidents of his later career that speak of the close acquaintance with all these things of shore and woodland; his complete devotion to botany in his course at the Rensselaer School, his accurate understanding of the sea-shrimps when making comparisons between them and their extinct ancestors of the Silurian waters, his close knowledge of the anatomy of the mollusks, the starfishes and sea-urchins, which was made evident in his palaeontological writings; all these seem to tell of his inquiring mind scrambling with his active body over tidal rocks and flats, through the meadows and woods of Hingham.

The resources at home were always slender. To this he has himself referred. 'Even in his day the village boasted an endowed school, the Derby School,

⁴ Memorial of Thomas Tracy Bouvé: Proc. Boston Soc. Nat. Hist., v. 27, p. 240, 1896.

of historic and present excellence, but James could afford only to attend the grammar school; and he tells of working hard Saturday afternoons and other odd times, to raise money enough to go to evening school too. This grammar school was kept by Increase N. Smith, a young master with whom he maintained an intimate friendship for years after he had left his home. Whatever the two had been to each other in village days, inside and outside of school, they were compensating critics for twenty years after they had separated. Hall, the enthusiastic student at the Rensselaer School and aspiring geologist at Albany, was ever trying to lead his teacher into the paths of science by sending him minerals, shells, stuffed birds, and book after book on geology, all of which were faithfully studied; and the account was balanced by the schoolmaster with a return in criticism on the evil English used in the reports of Hall's colleagues on the Natural History Survey. "We closet naturalists," he says, as he points to various false syntaxes, "like to read the results of the active observers in language we can understand." The student had been well schooled by this master and Hall never wrote slovenly English; indeed his early reports were couched in singularly perspicacious language; and the introduction to his great report of 1843 is a masterpiece both in thought as well as expression.

The dominie tells him, in these days, of the wonders of his developing *Sphinx* — how he has burst his shell and come forth to greet the May morning; in another letter it is a turtle that inspires his pen. Now he is puzzled over his shells: "I get hold," he says, "as we are all apt to do in many of the concerns of life, at the wrong end. I gaze away at the *base*, and lo, it turns out to be the *vertex*"; again, the boys have brought in another chrysalis to the school, but he turns from it quickly to say that he is reading the Prometheus Bound, "a little theology, Latin and history," and is happy to hear that Hall is continuing his Latin, adding the pleasant assurance: "You will of course never become a thorough linguist," as though he had seen many evidences of restiveness under the constraints of the "classics." This friendship which I can reconstruct only from the schoolmaster's letters, is an impressive evidence, though but one of many, of the loyalty of the young Hall to his boyhood friends. Each seemed seriously to inspire the other with his aims and purposes and both reaped the harvest. And then in later years, in the last of the schoolmaster's letters, after he had left Hingham for Dorchester, and when his pupil, in 1849, was climbing upward to his fame, he writes in acknowledgment of a copy of Hall's Harvard address: "I accept it as a proof that some reminiscences of our *palaeic* friendship still exist. Can

it be that you can read so positively the geologic history of the past? Are you not drawing upon your imagination? It seems like magic. You tell such palaeontologico-Munchausen stories that I am almost tempted to cry out with the poet of old, '*credat Judaeus, non ego!*'"

There is many another faded letter to bear witness to this treasure of boyhood friendships, but of them all none are so enduring a monument as a bundle of yellowing sheets, the first written in 1828 and the last in 1893, covering a stretch of sixty-five years. These are the letters of Charles S. Kendall, later of the Boston publishing house of Gould, Kendall and Lincoln, and in after years of Rice, Kendall & Co., paper manufacturers, still a name of high repute.

The almost century old devotion of these boys is a pleasing picture. In 1828 the young Kendall is at school in Boston and has been trying to buy some books for his friend James, and these were "to be left at Mr. Hickey's store," in Hingham. It is June, and James is returning the favor by sending up by the packet a basket of strawberries, which "I am sorry to say were all spoiled," writes Kendall; adding that he now has a place in Pierce and Williams's Bookstore at the foot of Market Street, where Hall is to come and see him; but Hall is not to send him any more berries because he doesn't *deserve* them, having let the others spoil; he hopes

for a letter at least once a fortnight — and ends his missive with a glorious pen flourish and a genuine American boy explosion, “George Washington Forever!”

A letter to “Friend James” early in the winter of 1829–30 carries a thrilling description of the burning of Dr. Lyman Beecher’s “Meeting House” in Hanover Street, with its organ and sacramental plate, its collection of “Minerals found in almost every part of the world, Lava, Wood, Heathen Gods, and one or two MSS. written on parchment, that were found in the Ruins in Greece, supposed to have been written ‘hundreds of years ago’”; together with a “cellar full of figs, wines and brandies, owned by a wealthy man who is able to lose it.”

So these letters run on full of interested inquiries about the home folks and answered doubtless with the little gossip of the town. All through the years of their lives the missives ripple back and forth, Kendall now applauding Hall’s successes, now scolding at his improvident waste in not turning his talents to money making; again and again helping him with his practical business counsel, upbraiding him for his sensitiveness and irascibility; he was the confidant of all Hall’s troubles, real and fancied, rejoiced in his fame, and doubtless was the one friend in his life whose finger was on the pulse of all his years; and at the bottom of this pile

I find one written in the last year of Mr. Kendall's life, 1893. It is now the letter of one octogenarian boy to another looking back through a silvered haze over the years to Hingham.

"I think we met each other in 1826. I was with Uncle Cant that summer * * * and I can well remember the visit you made me in 1828 or 29 while I was in the Bookstore in Cornhill and you on your way to the Rensselaer Institute,—on foot all the way!"

Mr. Hall's attachment to the place of his birth, of his schooling, his struggles at chores and store-keeping, kept a strong hold on him in later years. He visited Hingham frequently for brief summer stays on visits with his friend of many years, Thomas T. Bouvé,⁵ loyally deposited his money in its banks, and to the end kept in order his parents' burial plot in the old cemetery where he himself hoped to be buried — though it was not so to be.

Right here is the place to take note of a singular errancy in these home influences. There is not a trace of evidence that this eminent geologist was at any time interested in or attracted by the rocks of Hingham, which confront the observer on every

⁵ There are still many living witnesses to the helpful service to science, of Thomas T. Bouvé, "the ironmaster" of Boston and Hingham, an amateur but accurate student of science, its patron as president of the Boston Society of Natural History for ten years, and a man of large affairs.

hand. They are, indeed, vastly altered and crystallized sediments invaded frequently by volcanic intrusions and with a cryptic mineralogy which would naturally have puzzled a boy who must be attracted first by the more obvious; but the great conglomerates among these crystallines, speaking today of a possible glacial action in the carboniferous days when these now deeply altered rocks were laid down by the waters; the later glacial scratches and scorings of the rock knolls; the elevated beaches standing out conspicuously as banks of sand, traces of the ancient lake which has now been christened Lake Bouvé;—none of these phenomena seems to have left any tangible impress on the future geologist or to have, in youth, invited his attention. Professor Woodworth has very happily said: "The gnarled and topsy-turvy stratigraphy of Eastern Massachusetts may afford a birthplace for a James Hall but it will not rear him."⁶

Hingham was then as much within the magnetic field of Boston as it is today, and what influences in developing the young Hall we fail to find in the eddies and hills, we may well look for in the personal emanations from across the South Bay. During Hall's boyhood, Dr. Martin Gay had come to live in Hingham, a Harvard graduate who had

⁶ J. B. Woodworth, in the "Life of Charles T. Jackson," *American Geologist*, 1897, p. 78.

become an expert analytical chemist and was to acquire distinction for his writings on medical jurisprudence. In his earlier years, Gay was a public lyceum lecturer in Boston and the villages round-about; and his chemical expositions greatly attracted James, and indeed Gay was very much attracted by the boy. Soon it came about that Hall was helping Gay in the arrangement of his apparatus and his demonstrations before audiences, first in Hingham in 1830 and then in Boston. The help of this hand was of all things what the aspiring and interested boy needed most. More than that, contact with Dr. Gay, who was not very much Hall's senior, must have brought him in touch with that very exceptional coterie of men who were actively concerned in bringing about the organization of the Boston Society of Natural History.

The Boston "Linnean Society" had furled its colors about 1823, and the active scientific spirits of Boston from this time on were as sheep having no shepherd, until the launching of the "Boston Society" in 1830. We shall see some of the men in the pages of this memorial, but besides Gay, these at least need mention here: Amos Binney, who had been educated at the Derby School at Hingham and whose scientific tastes had led him from merchandise into medicine and from the State legislature into the Mollusca—a brief but brilliant and helpful career; George B. Emerson,

the educator and botanist, a man whose interest in the training of youth must have had its direct effect on the boy who was doing the neighbor's chores and tutoring backward children to get enough money to pay for night school and Boston lectures; Augustus A. Gould, conchologist, whom Hall long years after characterized as "full of the love of his fellow men;" and Dr. D. Humphreys Storer, the eminent dean of the Harvard Medical School and authority on reptiles and fishes; these still standard names in the annals of our science must have been, it would appear from the correspondence of later years, friendly harbor lights in guiding the career of this youth.

They were all men actively concerned in the founding of the Boston Society, and several of them, particularly Binney, Emerson and Storer, were organizers of the Natural History Survey of Massachusetts.

CHAPTER II

THE RENSSELAER SCHOOL

STUDENT AND PROFESSOR

Goes to the Rensselaer School — The “ Rensselaerean plan ” — A school of natural science — Amos Eaton ; his Geological Surveys — Stephen Van Rensselaer — Joseph Henry — Eaton and Hall — Hall’s enthusiasm — Character of the graduates — Abram Sager ; his distinguished career — Wells Williams, orientalist — John Wright, botanist — Alexander Van Rensselaer, philanthropist — Douglas Houghton, geologist — Hall’s love for botany — His graduation — His physical appearance and vigor — Witness of Joseph Henry’s experiments — Hall’s tribute to Eaton — Eaton’s extraordinary influence — Eaton’s “ Text-book of Geology ” — Geological excursions ; the Helderberg Mountains, Schoharie — John Gebhard, Sr. and Jr. ; their pioneer work in geology — Hall made Professor — Collecting trips and lectures — School activities at Troy.

THROUGH the boyish years from 15 to 19 these Boston influences and associations may well have taken firm grip upon the young Hall ; there were cruises afoot around the bay from Hingham or by boat across it, in order to share in them ; but there is nothing to show among the records of Hall’s life just what it was that turned his youthful resolution upon a life of

science or his attention to the new school just started at Troy, N. Y., under the foundation of Stephen Van Rensselaer, Patroon of Albany, and the direction of Amos Eaton. Perhaps neither of these requires explanation. The nascent tastes of the boy were excuse enough for the former, though it was resolution of no mean grade that could impel an impecunious lad to such an extraordinary venture for those days.

The Rensselaer School had already become known as an entirely new departure in the education of boys. Nothing like it had appeared among American institutions, either in its curriculum or in its pedagogic mode. This "Rensselaerean Plan," as it was designated by the Senior Professor, Amos Eaton, in an early circular regarding the school, took cognizance of the fact that "the aspiring energies of youth had been chained down to a kind of literary bondage," and that "a method was loudly demanded which should be adapted to the native curiosity and ardor of youth." The new foundation was a determined break-away from the conventional classical school; in other words, it was a school of science in which science was taught by personal contact in laboratory and field, and by classroom functions in which students lectured while professors listened.

Not in any sense was the institution a school of civil engineering. Such a consummation seems

not yet to have entered upon the vision of its director.

If one science was singled out for preference or special notice, it is indicated on the back of this circular of 1827, where it reads that "In addition to the above expenses it is now required that each student take two short mineralogical tours to collect minerals for his own use, for the purpose of improving himself in the sciences of mineralogy and geology."

Hall went to the Rensselaer School in 1830, two hundred and twenty miles afoot; and he graduated in 1832. It is bootless to ask how he managed it, where he got the money, the one hundred and eighty very necessary dollars a year: "Without exact economy," said the circular of 1827, "it will cost more." Perhaps some of the silent voices we have indicated above might tell how this was provided. It must have been not merely the Rensselaer School and its novel methods that so much attracted, as the widespread and steadily rising repute of its great Senior Professor. Amos Eaton, who had studied law with Alexander Hamilton and science with Benjamin Silliman, had been so inspiring a lecturer on various branches of natural science at the Troy Lyceum and over the country-

¹ The civil engineering course was not projected till 1834 and did not become effective till 1837. See letters of Dr. John Wright and Eben N. Horsford.

side of eastern New York and western Massachusetts, that he attracted the attention and good will of leading patrons of learning. Chancellor John Lansing, Jr., of the Regents of the University, in 1819 bore the expense of a survey of the Helderbergs and Catskills and accompanied Eaton throughout. It was Eaton, while a public lecturer, who first turned the young Joseph Henry from his dreams of a life devoted to poetry and the drama, into the fascinating fields of science. Stephen Van Rensselaer, the Patroon, commissioned Eaton to conduct the Agricultural-geological surveys, first of Albany County and then of Rensselaer County, in the years 1820-22, the first undertakings of their kind in America, perhaps anywhere; and on this Rensselaer County survey the future discoverer of the principles of the telegraph and telephone, of electrical induction and the dynamo, the coming first Secretary of the Smithsonian Institution, Joseph Henry, was his assistant. Thus Henry was a geologist first; the rest followed.²

Again, the Patroon supported Eaton on a great geological enterprise, the Geological Survey of the Vicinity of the Erie Canal (1823), that wondrous great new water-way conceived and executed by DeWitt Clinton, New York's foremost and first apostle of her natural resources. This survey was

² The series of specimens collected on this geological soil survey by Joseph Henry are still preserved in the New York State Museum.

an extraordinary undertaking and extraordinary in its accomplishment, for it gave a cross-section of the rock formations from Williamstown, Mass., on the east, to Buffalo on the west, supplemented by a section, made by Edward Hitchcock, across the State of Massachusetts. It was this man Eaton who was inviting to the Rensselaer School the youth of the east by his tactile, ponderable, eye and wit-training instruction; a naturalist in the old-time meaning of the word; author of text-books on geology, botany, zoology, chemistry, prepared for his own students and among the first of their kind in America. This inspiring genius, not yet a civil engineer even as that art was then practised, directing a school which was not conceived as a school of engineering, still remains, in spirit and method, the tutelary divinity of the great engineering organism into which this school has, by acquisition and inhibition, developed; the Rensselaer Polytechnic Institute.

With such a man the young James Hall was to cast his lot, and keenly indeed did the man and the boy warm to each other. The magnet had found its armature, and Hall turned with unrestrained delight to the new practises in education so remote from the weary hours of candlelight at home, poured out over delphine editions of Vergil and Horace. Hall's first love was for botany and his first recorded achievement was in this line;

naturally enough, for his preceptor had been professor of botany in the famous Medical College of Castleton, Vermont. The "Catalogue of Plants Growing Without Cultivation in the Vicinity of Troy, N. Y.," published in 1832, was the first ripple in the long and strong flood of scientific records to flow from Mr. Hall's pen for sixty years to come. Here on my desk lies a fragrant scrap of memory of those days, a bit of paper bearing in boyish pen, "To Dr. T. R. Beck; Ferns, reeds, etc., for the [Albany] Institute, from James Hall Jun."³ We shall have occasion to speak again of Beck, the social and scientific arbiter of the Capital city and at this time Vice-president of the Rensselaer School.

Professor Eaton was a well-trained devotee of the old science of botany but he was an enthusiastic pioneer in the new science of geology, with notions as to the interpretation of geological facts and phenomena quite exclusively his own. We need not pass his system or his interpretations under review here.⁴ Their defects seemed glaring to his

³ "James Hall Jun." was his usual signature at this time and up to his father's death in 1836.

⁴ The first edition of Eaton's Geological Text-Book was so sharply attacked by a critic in the *North American Review* for April, 1831, that both General Van Rensselaer and Professor Silliman came to its defense in the *American Journal of Science*. The enemy moved upon these defenses in a bitter personal attack in the short-lived *Monthly American Journal of Geology* and in this he was supported by its editor, G. W. Featherstonagh.

contemporaries but their merits have grown with the years. Their justification, however, is complete, so as they bore fruit in such men as Douglas Houghton, Ebenezer Emmons, James Hall, Abram Sager, George H. Cook, Michael Tuomey, John Wright, and Eben N. Horsford.

Here Hall came into first contact with Dr. Ebenezer Emmons, a rather momentous conjunction for them both and for American geology, as time would have it. It was the relation of student to instructor, for Emmons, at the time of Hall's entrance, was Junior Professor of Chemistry and Mineralogy, and had just issued for the use of the Rensselaer students his manual of mineralogy and geology which was the best book of its kind.⁵

It is not difficult to picture the joy of Hall's life in his years at the school. Under the practical guidance of enthusiastic teachers he was brought into direct contact with the objects which his soul had adored but had hardly dared to cherish. If he were ever troubled by an admonition of the spirit over his unpractical love of chemistry and flowers and sea life, his enthusiasm crowded out the unwelcome intruder and he gave himself to a revel of

⁵ Manual of Mineralogy and Geology: Designed for the use of Schools; And for Persons attending Lectures on these Subjects, as also a convenient Pocket Companion for Travellers in the United States of America. By Ebenezer Emmons, M. D. Adopted as a Text-Book in the Rensselaer School. Albany. Printed by Websters and Skinners. 1826.



From a miniature about 1832

his instincts. In his old years he spoke often and feelingly of his days at Troy and his love for his preceptor, Eaton. But his doings there were, to him, nothing out of the ordinary, nothing but what others about him were doing, and so we have his own record of but few of the incidents of these years.

We may picture for a moment the incentives this school was imparting to its boys. It is well to remind ourselves of these early inspirations. At this period every one of these lads seems to have become entirely captive to some branch of natural science, if not to several. Abram Sager⁶ is enthu-

⁶ Dr. Abram Sager, after pursuing his medical studies at Yale and the Castleton (Vt.) Medical School, went out to the Mississippi in 1835 in search of a place to locate as a practitioner, and after various experiences brought up at Chicago. "Famed Chicago!" he writes, "a city of about 3,000 inhabitants, not set upon a hill but stuck in a mud-hole so deep that ordinary wheeled vehicles were caught in the mud." He left forthwith for Detroit, settled down for practise, and while waiting for patients had plenty of time for the collection of birds, reptiles, shells and plants. Detroit was then a lively military post which was attracting many civilian pioneers of intellectual tastes, and the interests of the Michigan territory were effectively represented at Washington by Senator Lucius A. Lyon. Here Sager soon met Douglas Houghton and was invited to join (1836) the Geological Survey of Michigan in the capacity of Botanist and Zoologist. These departments were discontinued in 1840. That year Sager writes to Hall: "Our baby University is expected to walk next fall"; and Asa Gray had been appointed to the chair of botany and zoology. Gray did not remain long and Sager was made his successor. Doctor Sager created a strong department and a great herbarium, still known as the Sager Herbarium. Subsequently he became more intimately connected with the Medical School of the University as president and professor of obstetrics and materia medica.

siastic over the finding of a plant the "Prof." has never seen before in that vicinity. Abel Storrs⁷ tells of the boxes of minerals under his bed; William S. Sanders writes out lengthy directions as to where, when, and how to collect the plants of the region; Samuel W. Williams⁸ is negotiating exchanges of minerals; John Wright⁹ is covering all the country between Troy and Williamstown in search of plants and reptiles; Alexander Van Rensselaer¹⁰ was keenly engaged with "stones, weeds,

⁷ Abel Storrs was an adjunct professor in the school. Though he settled down in after life to the prosaic labor of New England farming, he maintained for years a lively interest in every branch of natural science.

⁸ Samuel W. Williams, better known in after life as S. Wells Williams, was the distinguished diplomat and oriental scholar who spent a large part of his active life in China, going out in charge of a missionary press but eventually becoming the most eminent student of the Chinese language and dialects that America has produced. The later years of his life were spent as Professor of Chinese and Oriental Literature at Yale College. Doctor Williams was a life-long lover and collector of beautiful minerals.

⁹ Dr. John Wright, Hall's collaborator in the "Catalogue of Plants," on the recommendation of Hall to Sager, was appointed botanist on the Michigan Survey (1837). There seem to have been some heartburnings in the East over this appointment, and Sager writes to Hall of the hostile attitude of Torrey and Gray toward this pupil of Eaton. "They seem disposed to ask," he says, "can any good come out of the Rensselaer Institute?" Doctor Wright died early.

¹⁰ Alexander Van Rensselaer was a son of the Patroon and Founder, and when he graduated chose medicine for his profession. Free from any necessity to practise, he gave his life almost wholly to religious and philanthropic work, and is still remembered for his good samaritanism in connection with the old Five Points Mission in New York City.

and bugs," to use his own language; and Hall himself, while searching the material for his first publication the "Catalogue of Plants," etc.,¹¹ was assembling minerals and fossils from all directions. Eaton tells of "thousands of specimens of fossils" brought into the lecture rooms by the pupils.¹²

Douglas Houghton, to whose scientific survey of Michigan reference has been made, was the first of Eaton's students to attain distinction in science. He was older than the rest of this interesting coterie of boys, having graduated in 1829 from the Rensselaer School to which, it is said, he had been sent as a representative student from the schools of Chautauqua county, N. Y., because of his extraordinary qualifications. While he was still at Troy in the capacity of adjunct professor, application was made to Eaton from the Military Post at Detroit for a lecturer on science, and Senator Lyon came on for the purpose of seeing Professor Eaton personally about the matter. Eaton recommended Houghton, and the young man, just 21 years old, went out. The next year he returned to his home in Fredonia, N. Y., and practised medicine, which he had studied at Albany after graduation; but he had become infected with the western fever, went off again to join one of Schoolcraft's expeditions up the Mississippi as physician and botanist, and was soon back in Detroit pursuing a medical practice. There he was

¹¹ When Professor Hall's estate was broken up his collection of plants "from the vicinity of Troy" was found carefully laid away and smoothed out between old newspapers of the dates 1830 to 1832: copies of the *Hingham Gazette*, sent out from home; and of the *National Intelligencer*, the *Albany Gazette*, *Troy Centinel*, all with the superscription of Professor Eaton; intimating how the teacher had helped the boy in preserving his collections.

¹² *American Journal of Science*, 1833, p. 399.

active in all civic matters; he organized the Michigan Geological Survey, surrounding himself with young men from the Rensselaer School as scientific assistants; became Mayor of Detroit, and Professor of Geology when the University of Michigan was founded. The memory of the "Little Doctor" is still cherished in the State of his adoption.

Doctor Houghton was drowned in Lake Superior in 1845, by the upsetting of his canoe while on one of his geological expeditions.

Hall was just reaching his majority as time for graduation from the Rensselaer School came, in 1832. At this point of his life we may picture him as a stocky young fellow of hard muscles and perfect organic functions; an expanding calvarium thatched with thick, black hair overhung a pair of confiding, half-frightened, pale-blue eyes which seemed out of keeping with his tough biceps, his brazen gluteus and his easy irascibility, but were nevertheless, when making a new acquaintance, an index to an absolutely trustful but watchful reception. His physical vigor always fine, he was never sick. When he started for St. Petersburg, at eighty-five, his physician assured him that his organs were in perfect condition. When he died he was not sick—he simply stopped living. But all his life his nervous system was strung taut as an aeolian harp, and mournful discords it gave out when the wind blew from the wrong quarter. "He has been a dying man for fifty years," once

said to me his venerable physician, Dr. Thomas Hun. In perfect health of body and mind, Hall gathered up the inspirations he had caught in the Rensselaer School, and graduated.

The class of 1832 was not a large class. It had but four members. Of these one became a physician, one a railroad president, and the fourth was the distinguished orientalist to whom we have just referred, S. Wells Williams. A better idea of the men then made in this school may be drawn from a larger class of this period. I take the class of 1829, of eleven men. Of these three became physicians, two lawyers, one a teacher, one a minister, one a civil engineer, one a geologist (Houghton), and two died too early for a career. The school was surely a school of "many arts" long before it had assumed the name of Polytechnic Institute and attained its eminent standing as a school of the "many arts" of engineering.

Thus in 1832, Hall was set free; equipped with high power enthusiasm for natural history, a large capital of seemingly unpractical information, and what might have been to some boys, an uncomfortable indebtedness.

One of the incidents of Hall's senior year, which has become a matter of important record, is his visit to the Academy at Albany in company with Abel Storrs to see the curious and interesting experiments which were being carried on there by

Professor Joseph Henry, to whose geological work we have already referred. Hall brought a letter of introduction from Eaton to Henry, and he was thus permitted to visit the famous "upper room" of this historic Academy and watch Henry send a current from a simple galvanic cell through a mile of copper wire and into induction coils, creating a magnet by whose attraction a bell was struck at the distant end. I think I must be one of the few persons living who has heard a witness of this classic experiment of 1832 describe it, and it is little wonder that this diminutive bell which rang out the first proclamation of modern electrical achievement is prized and enshrined in the State Museum for its message to mankind. Long years after, when Professor Henry had been compelled by Morse to prove in the courts his priority in the demonstration of these elementary principles of electrical transmission, he asked Hall to write out his recollections of this visit, and they have been set down among the memorials of the great discoverer.¹³ (See later page.)

To his teacher Hall ever acknowledged his profound indebtedness, and the tribute he paid to Eaton at the semicentennial of the Rensselaer Institute seems to be the just and adequate testimonial of one who best understood the man:

¹³ See Memorial of Joseph Henry (published by order of Congress), p. 381, 1880.

"In the progress of civilization it is not the slow uniform motion of the great masses that helps it forward, but the few men who come out from them and strike a new key. Professor Eaton taught us the manipulations in science with the simplest materials, so that a student could go into the forest and construct a pneumatic trough or a balance, and perform there his experiments in chemistry or physics. To his memory we owe much. His name has been neglected before the public, but cherished in the bosoms of those who knew him — a man capable of interesting young men, having a brain one-fourth larger than that of the mass of mankind, and that brain devoted to the services of science. If we with great means do what he did with small, we shall deserve well of coming generations."¹⁴

¹⁴ The references we have made to Professor Eaton and the tremendous influence he exerted on the youth of Hall's generation through his novel educational practises, may well be supplemented by allusion to the influences of Fay Edgerton, a graduate of the Rensselaer School in 1826. Mr. Edgerton, imbued with Eaton's enthusiasm, became a teacher of science in the Utica High School, and James D. Dana and Wells Williams were among his pupils. "Great was the delight of the boys," says Dana, "in [his] botanical and mineralogical experiments and their pleasure, too, in the lectures in chemistry." At that time Doctor James Hadley was not far away, as professor of chemistry and materia medica at the College of Physicians and Surgeons of the Western District of New York, at Fairfield — he of whose distinguished son it has been often said by an even more distinguished grandson (the late President of Yale University), that the most effective training in science given in his day at Yale College was his father's course in Freshman Greek. Asa Gray, whose name still leads the list in American botany, was Hadley's pupil at Fairfield and Mr. Edgerton's successor in the high school at Utica. Mr. Edgerton's life was short, but even in my own day as a teacher in succession in the Utica school, there were traditions and traces of him still influencing or having influenced lovers of natural science there; of whom were Watson Williams and Robert S. Williams, father of the late Professor George H.

Professor Eaton was a prolific writer of texts on science; he swept the entire circle, but it happened that he did not prepare his "Geological Text-Book" until about the time of Hall's arrival at the school, and the second edition of the book with the first illustrations of fossils, in June 1832, just at the time of Hall's graduation. This book set forth his very positive declaration of dependence upon the classification of rock formations adopted by European geologists, but at the same time attempted one of his own which, though obviously based on too feeble knowledge, yet contained the germ of an important conception; that of cycles of sedimentation, or the rhythm in the rise and fall of the sea bottom indicated by repetitive succession of coarse to fine and fine to coarse. Indeed, this seems to have been the first enunciation of a principle which is now fundamental to accepted inter-

Williams, geologist of Johns Hopkins University; Egbert Bagge and Ezekiel Jewett.

And perhaps these memories of Eaton, a man whose influences have fertilized generations of students, should not be unaccompanied by a passing reflection upon the remarkable inscription of his first textbook, the *Manual of Botany* (1818). In words almost of invocation he calls upon the Reverend Zephaniah Swift Moore, the Reverend Professor Chester Dewey and the Reverend Professor Ebenezer Kellogg, to accept that testimonial of his gratitude: "I am indebted to you," he says, "for a passport into the scientific world; after that protracted series of misfortunes which sunk me to the lowest ebb of human misery." To have turned, with the uplifting hand of science, such a spirit from darkness to light and set him up upon his feet again, was in truth a service to mankind.

pretations of stratigraphic succession, and as we look back over the historical development of the science it is to justify Eaton in the recognition of geological succession so controlled as not to fit the European categories. He failed to fortify his propositions, his contemporaries reprobated them and his successors ignored them; until John S. Newberry, a half-century after, brought forward the conception in clearer definition, and Charles Schuchert interpreted it in terms of changing continental shelves.

School over, Hall started off afoot to make a geological tour through the Helderberg Mountains whose base lies twenty-five miles away to the south of Troy. No one but the young geologists of the Rensselaer School knew much in those days of this extraordinary plateau of palaeozoic rocks, where the formations rise in successive and almost horizontal terraces, with sharp delineation, from the upturned strata of the Lower Silurian below, into the Old Red Sandstone of the Catskills which cap them. It is the section which Sir Charles Lyell, when "pumping" through this country ten years later, said every geologist must know if he were to understand his science.¹⁵ I presume this trip must

¹⁵ The distinguished author of the "Principles of Geology" was known to his colleagues of many countries as "The Pump," a jocular reference to his acquisitiveness of their information and his practise of putting them through critical cross-examinations.

have been by way of the Indian Ladder to the lofty first terrace which commands the extraordinary panorama of the confluent rivers, the Mohawk and Hudson, thence on up across the "Sperry limestone" and "Cocktail grit" and "Cornitiferous" into the "Greywacke" of Rensselaerville, and then probably down into the Schoharie Valley where the rock sections had already been deciphered by the John Gebhards, senior and junior.¹⁶

¹⁶ When the history of geology in the State of New York shall have been fully written, the pioneer work of these Schoharie men will be given its better share. In the years of the 1820s and probably earlier, John Gebhard, a farmer at Schoharie Court House, was studying the limestone caverns of this retired and beautiful valley and collecting therefrom their quite extraordinary minerals: strontianites, celestites, gypsums, barites, etc. Little knowledge of such things had found its way into the complacent meadows and hills of this embrasure, but gradually the collector came in touch with those of the outside world who were zealously appreciative of his discoveries and eager to share in them. A bundle of his letters on my desk, of the 1820s and early '30s, shows how eagerly he was pursuing the exchange of these Schoharie minerals for those of other sorts from elsewhere. There are negotiations with James Hadley of Fairfield Academy; with Rubens Peale of Philadelphia; William Horton of Goshen, afterwards an assistant to Mather on the Geological Survey; Ebenezer Emmons and Professor Eaton. There was little light to guide this Schoharie pioneer — Cleaveland's Mineralogy, perhaps, and the accounts of Buckland's discoveries in the Kirkdale caverns; but the name and doings of William Smith had then hardly reached even the college centers of America. Hugh Miller was still carving gravestones at Cromarty and Robert Dick baking loaves in his Thurso ovens. But John Gebhard, with the help of his much-loved but illegal son, was doing in New York in 1820-30 what the founder of historical geology, "Strata" Smith, had done in the counties of England: collecting the unnamed fossils of the rocks, arranging them according to the strata in which

Back from this fifty-mile tramp, his sack and pockets full of fossils, Hall seems suddenly to awaken to the fact that all his money is gone and that he is without resources or prospects. Perhaps

they were found, and so by their aid tracing the rock formations throughout the extent of the Schoharie hills. All this was done under an instinctive guidance aided little by suggestions from without, and this is an extraordinary fact when set alongside the influences which impelled William Smith, Miller, and Dick. When Eaton's "Text-book" reached Schoharie, Gebhard wrote to its author telling him something of his own work, assuring him that he had a better rock section than Eaton had seen, "full of organic remains," sent him a profile of it, and told him about his fine "lily-encrinite, the first that has been found in this country."

When the Natural History Survey was started, John Gebhard, Jr., was appointed by Mather as assistant for this part of the First District, but Mather fails to say that the rock section which he printed in 1843 had been worked out by the Gebhards nearly twenty years before. After the Survey was over and the State Museum was organized, John Junior was made its curator. Twice his great collections were purchased for the use of Hall in his preparation of the Palaeontology. He did not long remain in Albany, but went back among the Schoharie hills to fulfil his duties as Justice of the Peace in his valley and to follow the desire of his heart, the peaceful pursuit of fossil hunting. In his old age he came back to the Museum again. Born in 1800, the same year as Emmons and Hugh Miller, "Squire" Gebhard was 86 when I first knew him. He was a benignant man, honored and greatly beloved in his valley for deeds of kindness that are the crown of science. Full of interesting reminiscences, he has told me of the visit which Lyell made in 1841 to see his fossils; and when the eminent traveler was shown a slab of the "Tentaculite limestone," covered with the awl-shaped shells, he declared them to be spines of a sea-urchin, advising Gebhard to look out for the body of the animal from which they were broken. He did look out for it and in due time discovered the great chambered crinoid-bulb, *Camarocrinus*, which he characterized as "Lyell's sea-urchin." John Gebhard, Jr., died in Albany late in the year 1886.

even there intruded on his reflections the money he had borrowed for his education, and a certain troublesome note for four hundred dollars which he had given to Ebenezer Emmons. Professor Stevenson tells the story that Hall, busied in packing up his traps preparatory to leaving Troy, was interrupted by Eaton, who asked; "Hall, what are you doing?" He was packing up; he had no more money and no way to earn any; he didn't know just where he was going or what he was going to do. "We can arrange all that," said Eaton, and told him to stay. In keeping this promise he made a place for Hall as librarian of the school in the reading room of the Old Bank Place building, the first home of the institution on the river shore at the corner of Middleburgh Street.

The young man was now a B. N. S. (Bachelor of Natural Science), that being his graduation title. Soon he received his Master of Arts, and in the same summer was made "Assistant to the Junior Professor of Chemistry." Thereupon he was off to Carbondale to collect "vegetable fossils," as Eaton called them, and on the basis of the large collections of fossil ferns he brought home, Eaton was able to determine to his own satisfaction that the Pennsylvania coals were of "secondary" age and thus equivalent to those of Europe.¹⁷

¹⁷ American Journal of Science, 1833, vol. 23, p. 399. See also John J. Stevenson's graceful memorial tribute of Hall given before the Geological Society of America. Bulletin v. 10, p. 426, 1898.

The young professor was now settled for a while in Troy while his classmates scattered. That he was a successful teacher of chemistry and very greatly esteemed by the students there is plenty of evidence. His salary was only a few hundred dollars but he was permitted to earn what he could outside, so he lectured over the countryside — on chemistry at Waterford, and on chemistry and botany at Hoosick Four Corners. In Hingham days he had thought of studying medicine, and now he did do something at it, just how much we do not know. A classmate who is doing the same thing in a country village in Washington county urges him to come there, and if he was short of money "he can get board and washing for \$1.50 a week." Hall did not go, but in after years he received from the University of Maryland the honorary degree of Doctor of Medicine, perhaps in recognition of these intentions. He kept closely in touch with his scattered friends, urging them to make collections, especially of minerals, and to exchange with him; and he was soon writing and exchanging all over the country wherever he could find a man who had anything in the line of scientific objects to exchange.

In those museumless days there was no way for the student of natural science except to build up his own collections, and Hall's extraordinary acquisitiveness swept him far afield in this scientific

business; indeed his collections came to play a large part in his active service not alone for their scientific worth but because in fact they furnished the financial support of many of his scientific undertakings.

Hall's affairs over his collections run completely through his life and did not even terminate with his death, for the largest asset of his estate was the great collection of fossils, minerals and books he left behind. From these early days of youth at Troy, his collections were a matter of exchange, barter and purchase, and so they continued to be to the end. When the New York Geological Survey was under weigh the geologists were free to make collections for themselves and they all did so. Afterward, when Hall organized collecting on a larger scale for the purposes of the Palaeontology of New York, he was allowed by law to take one-half for himself, and that one-half represented perhaps the one-half of his own money he put into them. As he bought, so he sold in order to buy more; and when the day of museums began to dawn, when colleges and universities were seeking scientific collections, he sold in order to begin all over again. Such procedure on the part of a public official and director of a public museum invited invidious criticism and was indeed a dangerous practise, but he cared nothing for the criticism; and

while many a strutting moralist whispered tales of his derelictions, he went on selling his lands and his securities that he might get together the materials he needed for the work he had in hand. His acquisitiveness was a virtue without the practise of which he knew his work could not be perfected, and hence it was boldly and manfully pursued.

That Hall was beloved of his pupils at Troy there are sheaves of evidence; that he was honored as an inspiring teacher and investigator there is not only the unfailing support of Eaton and Van Rensselaer to show, but such words as these from Abram Sager, who had gone on to complete his studies at Yale and writes from there in 1832:

“With respect to the standing of the Rensselaer Institute in this place I know but little for, except by way of interrogation, I hear nothing about it. You may form your opinion from this silence on the subject but this I can say for myself respecting the chemical course at this place and such as you had last summer. I should prefer your *one* to *two* of these courses. 'Tis true the experiments at the Yale College Laboratory are brilliant and impressive of course, but it is not like entering heart and hand in the business, as at the Rensselaer Institute and believe me, dear sir, I have learned to appreciate the value of the method of instruction at the latter place more fully than ever before and shall ever cherish the recollections of time, place and other circumstances of the school when I stayed there, with the fondness which an initiation in the sciences is calculated to inspire in an ardent mind.”

To which Sager adds in a later letter :

"The natural sciences are cultivated at this place with considerable ardor and success but still not as much as I expected to find them. To my knowledge at least, there are but few who devote much time to those delightful pursuits; among the college students Mr. James Dana, the friend and correspondent of S. W. Williams, is, I believe, reckoned the most successful, indefatigable votary."

And we may add here Sager's singularly brilliant portrait of the great Silliman in action :

"How are matters and things in general at the Old Bank? Prof. Silliman has a few days since finished his mineralogic-geological lectures which I have had the pleasure of hearing. You have doubtless read his *Tour to Quebec*, etc., and marked the glowing style in which it is written. It is not changed any more in his lectures than the subject requires and sometimes not that. Perfectly at home among the wreck and ruins of the world, in either hand balancing a flood of waters and a lake of fire before his respectable and attentive auditors, he stands like some kind but mighty spirit sent to instill into the minds of the rising generation the sublime but awful mysteries of the past creation, himself filled to bursting nigh with the majesty and grandeur of the subject."

All during the years of the Geological Survey Mr. Hall kept a more or less active association with the Rensselaer School, as professor of chemistry from 1835-41; and thereafter, for decades, as professor of mineralogy and geology; largely a position of courtesy, for in all this time he seldom lectured and his name was carried on the faculty

list as a mutual distinction. From this connection he derived his title to the appellation of "Professor," which throughout his active life was his preference.

So Professor Hall, teaching at the school and lecturing in the nearby villages; conducting his boys on field trips to the Schoharie caves, the Helderbergs, to Kingston, to Carbondale and Easton, Penna., buying and selling minerals and fossils; helping backward students over hard places; lending the poor ones money to pay their way; spending scraps of time in tidying up the school, whitewashing the "Old Bank Building" or straightening up the "sheep-pen" (the inglorious name that Aleck Van Rensselaer gives to the study room of the girl students of the school); with vacation days at Hingham and collecting trips to Acworth after beryls and to Chesterfield for tourmalines; making trips to the Rossie lead mines for General Van Rensselaer and reaping a great harvest of beautiful minerals; thus his time was spent till the movement to organize the great State Survey was afoot.

CHAPTER III

THE GEOLOGICAL SURVEY OF NEW YORK—ITS ORGANIZATION AND FIRST YEAR, 1836-1837

Popular appreciation of the Survey—Influences in its organization—Learned Societies—T. Romeyn Beck—Earlier influence of Governor Clinton—Hibernicus—Plan of John A. Dix—The Four Geologists; the Geological Board—Governor Marcy appoints Edward Hitchcock, William W. Mather, Ebenezer Emmons, Timothy A. Conrad, Lardner Vanuxem—The assistants; James Eights, Ezra S. Carr, George W. Boyd, James Hall—Constitution of the four Districts—Hall's first season, 1836—Reconstitution of the Third and Fourth Districts—Conrad retires—Hall made Chief Geologist of the Fourth District.

AS any adequate story of Hall's career must in effect resolve itself into a history of geological science in New York in the nineteenth century, with innumerable sidelights on the development of geology in America, it is here proper to interpolate a few paragraphs regarding the influences which brought into being the Natural History Survey of New York. This organized Survey of the great commonwealth was a really notable event in its civic history. It was so regarded by its people, for it was warmly espoused and its results warmly appreciated. It was allowed

to follow its original plan, complete its projected course, publish its reports with fullness and dignity, and to leave an impression so favorable both with the people and their representatives that, upon its formal conclusion, one of its departments, palaeontology, was continued, and a new one, agriculture, was erected. Compared with some of the other States, New York was slow in getting its Geological Survey started, but up to that time no State had undertaken such a comprehensive scheme for a general scientific survey.

The contributing influences which through the years were focusing public attention on the need of such a survey, have been often estimated, and perhaps never more clearly marshaled than by John A. Dix when as Secretary of State he set them forth in response to a request of the New York Legislature made in pursuance of a memorial from the Albany Institute in 1834. Though the Albany Institute, the Society for the Promotion of Agriculture, the American Institute of the City of New York, and other active learned societies had urged, consistently and continuously, an undertaking of the scope of this Natural History Survey, petitions and memorials for such an end are seldom so effective as the controlling direct touch of an influential personage. Before the birth of the Rensselaer School, Amos Eaton had lectured on science to the New York Legislature of 1818 and later

years. His power in that quarter was thus a ponderable quantity. General Van Rensselaer's commanding influence was so actively thrown in favor of this public project that he not only intimated preferences when the appointments were made, but he actually acted as banker for the appointees when they could not afford to wait for their salaries upon the slow procedures of the State's fiscal officer. Theodoric Romeyn Beck, M. D., Professor of the Institutes of Medicine in the College of Physicians and Surgeons of the Western District of New York (Fairfield), internationally known for his writings on medical jurisprudence, a Vice-president of the Rensselaer School, Principal of the Albany Academy, Secretary of the learned Albany Institute, and finally Secretary to the Board of Regents of the University; he it was who commanded the destiny of such affairs at Albany. To use Hall's expression, "he ran everything." His tastes were scientific; his brother, Lewis C., was teacher of mineralogy at the Rensselaer School; personally, socially, and officially, Doctor Beck's influence was very great, and in giving substantial impulse to this projected Survey, his judgment was much regarded in the executive chamber.

Back of these personal influences lay one earlier and still greater. It was the voice of DeWitt Clinton crying in the wilderness for a better knowledge and better utilization of the natural resources of

the State. It was a voice that had become attuned to the vast possibilities of the State during the projection and execution of his "big ditch," the Erie Canal. In his journeyings back and forth through the country it traversed, and during his three terms as Governor of the State, Clinton's letters, pretending to be the observations of an Irish gentleman traveling through the State and published under the pen-name "*Hibernicus*," show how intently his mind was addressed to this matter of its natural resources.¹

Following the plan of organization advanced by the Secretary of State, Mr. Dix, the Legislature of 1836 made provision forthwith for the Geological Survey. Under this plan no one man was to be "State Geologist," but the State was to be divided into four parts and men of equal authority and, it was hoped, equal competency, were to be put in charge, one for each section. This was an extraordinary provision which could have come only from the fine and broad perceptions of Mr. Dix and his counselors. New York, with its nearly fifty thousand square miles, was a State of great area, too large, it was thought, for one man to command. There were few experienced or well-

¹ "Letters on the Natural History and Internal Resources of the State of New York: By *Hibernicus*". These letters "first appeared in the columns of a newspaper during the year 1820"; in book form in 1822.

trained geologists among its citizens and none for so great a task. So it was roughly divided by physiographic provinces, and it was evident that the chief officers for these districts would have to be taken from outside. Such an arrangement would provide, it was believed, for an harmonious verdict after full discussions in council. It was a provision that led to most important results for the organization of American science, even though in the final decisions there was often one dissenting voice and a minority report. The joint conferences of the Geological Board led to the organization of the Society of American Geologists, later to the foundation of the American Association for the Advancement of Science; and the minority report brought on the years-long debate over the "Taconic question," with all its important determinations of fact, its cross-purposes and its acrimonious personalities. It was not often that William L. Marcy, then Governor, let go a chance for the practise of party politics, but in his appointments to these positions he eschewed them entirely, and offered the first commission to the Reverend Doctor Edward Hitchcock of Amherst College, whose Geological Survey of Massachusetts had given him prime standing in this science. To Doctor Hitchcock was to go the charge of the First District; that is, the southeastern district of the State from the Mohawk river down, including the

Helderberg and Catskill regions, and all the Hudson Valley counties. It was the most accessible, in its geology the most varied, and in many respects the most difficult part of the State. Doctor Hitchcock declined his appointment; it was too far off; he had a young and growing family and he could not stay away from them so long.

The choice of the Executive then fell upon four men for the four districts, all younger than Hitchcock and all from outside the State: William W. Mather of Ohio, for the First or southeastern District; Ebenezer Emmons, who had by this time removed from Troy and was a resident of Massachusetts, was selected for the Second District; Lardner Vanuxem of Bristol, Penna., and Timothy A. Conrad of Philadelphia, for the Third and Fourth Districts respectively. This choice was obviously governed by a purpose to select active and energetic young men for the rough exploratory work the undertaking required. And so better known men like the Rogerses, Dana, Silliman and Eaton, men already attached to colleges or otherwise of established position, were passed over.

Lieutenant Mather, for the First District, was a retired army officer, who had been a teacher of geology and chemistry at the United States Military Academy at West Point, and, at an earlier date a teacher in Wesleyan University. The year

before his appointment he had accompanied George W. Featherstonaugh on his exploring expedition from Green Bay to Coteau du Prairie. He was then thirty-two years of age.

Doctor Emmons, chosen for the Second or northern District, was thirty-six years old. He was a trained chemist and mineralogist, a doctor of medicine, and on leaving his position as teacher of chemistry and mineralogy at the Rensselaer School had become professor of chemistry at Williams College. Doubtless the good will of General Van Rensselaer helped in his selection for this distinctively mineralogical Adirondack district of the State.

Timothy Abbott Conrad, selected for the Third District, though of New Jersey birth, was a resident of Philadelphia, and closely associated with the Academy of Natural Sciences. He was a conchologist rather than a geologist, and had written somewhat extensively on this theme. It was really because of this that he was selected, for it was evident that some one on the Board must have a knowledge of fossils, as the rocks of New York were known to teem with organic remains and not one of the other three men knew anything about them. Conrad, then, was really palaeontologist for the Survey, and he cared so little for the work and title of Geologist that he forsook both after the first season.

Lardner Vanuxem, chosen for the Fourth District (of 1836), was the senior of the corps, having been born at Philadelphia in 1792, and he enjoyed the very unusual distinction of having studied at the Ecole des Mines in Paris. Mr. Vanuxem had published accounts of the geology of Pennsylvania, and it was thought that his knowledge of this neighboring State would throw needed light on the New York problem. Mr. Vanuxem was a wise and placid member of the Board, who enjoyed the cordial respect of his colleagues, while he tried to pour oil on their often troubled debates and differences. He lived only a comparatively short time after the conclusion of his work (d. 1848), not long enough fully to enjoy the honorable credit which his brief, concise, and accurate description of the Third District (of 1837) had won.

A few words further regarding the rest of the personnel of the organization. Each chief geologist was to have one official assistant. Most of them did, in fact, have different assistants in successive years, and often, as the work progressed, additional local helpers, but of them all only a few names have today any significance to the science. Reference has been made to John Gebhard, Jr's., work with Mather. Vanuxem's assistant for the first season was that extraordinary naturalist, Dr. James Eights of Albany, whom I have heard Hall characterize as the best informed man in

natural science he ever knew. Eights had, on his own account, studied the rocks of Central New York, covered by the Third and Fourth Districts, and had published some description of them in a little periodical for which he was the editorial sponsor, *The Zodiac*, a magazine of pretensions and excellence which had a few years of life in Albany before the Survey was organized, and he was therefore of immediate use in this field unfamiliar to his chief. Prior to this time, Eights had had a career of exploration in the Antarctic and an experience in many branches of natural science far more varied and comprehensive than that of any member of the Survey.²

Ezra S. Carr³ and George W. Boyd⁴ were also Vanuxem's as well as Hall's assistants in later

² I have written a brief account of the short scientific career of this unusual man (Scientific Monthly, p. 189, Feb. 1916), particularly of his discoveries in the Antarctic on the expedition under Captain Fanning, 1828, in geology, zoology, and botany. Only as the scientific results of recent Antarctic expeditions have been made known do the real merits of Eights's discoveries become manifest. Dr. Eights died at Ballston, N. Y., in 1883.

³ Ezra S. Carr did not actively join Hall until the season of 1838, after his graduation from the Rensselaer School. His subsequent career was distinguished. As a doctor of medicine he lectured at Castleton, Philadelphia and Middlebury, and was one of the *actual* lecturers, with Agassiz, at the "University of Albany." He became Professor of Chemistry at the new University of Wisconsin, and was a Commissioner of the State Geological Survey when Hall was called upon to undertake that service. For some time he was Professor in the Rush Medical College at Chicago. Then he moved to California, became Professor of Medical Chemistry in the Toland Medical College, San Francisco; afterward, as Pro-

years, both good geologists; and we shall presently have occasion to notice that later, Eben N. Horsford, afterward to become the eminent Rumford Professor of Chemistry at Harvard, was assistant to Hall in the Fourth District.

To Dr. Emmons, of the Second District, James Hall was assigned. It has been understood and stated that this appointment was brought about by the influence of General Van Rensselaer, and doubtless this is true, for except under some such pressure it is hardly likely that Emmons would select Hall for his companion in the field. They were two very unlike qualities; Emmons nervous and sensitive, Hall determined and headstrong. Affairs between them had not gone well at the Rensselaer School and Emmons had left for Williamstown, Hall taking his place as teacher of mineralogy at Troy. Hall had borrowed money from Emmons which he could not or would not pay—that iniquitous debt which grew to be of years standing and worked its way into the “Taconic” controversy.

fessor of Agriculture in the University of California, he acquired wide influence throughout the State, filled other scientific functions, but doubtless rendered his greatest service as Superintendent of Public Instruction in the State of California, a position he held till the end of his life.

⁴Dr. Boyd had been curator of the New York City Lyceum of Natural History, and when the Survey was being planned his friends urged him for the chief position in it. His service was very brief and he died in 1840.

To understand fully at the outset Hall's relations to this Survey organization, a few words must explain further the constitution of the four geological districts. They were made up of aggregations of counties: The First, of those constituting the Hudson Valley from Lake Champlain south and the Catskill region; the Second, the distinctively Adirondack counties; the Third and Fourth were very conventionally divided by an east and west line, following very irregular county boundaries and presumably splitting the central-western State in half, the Third at the north and along the Mohawk and Lake Ontario boundary, and the Fourth covering the highlands and the valleys of the "Southern Tier." This division line was laid to follow approximately the known east and west outcrops of the rock strata, and to divide them so that Conrad at the north got all the lower formations except along the Niagara river where a tenon was let in from the south to give one unbroken meridional section across his part of the State, and Vanuxem at the south all the higher; the man of the Third District thus getting no share of the other's allotment or any acquaintance with the rest of the geological succession.

In this organization, unusual and effective as it was, there were already three "bad starts," points of weakness that have a decided effect on this narrative. The first was Hall's appointment as assist-

ant to Emmons; the second, the delimitation of the Third and Fourth Districts of the State; and the third, the appointment of Conrad. The last two, after one season of disadvantageous work were profitably corrected, but the first was fruitful in trouble.

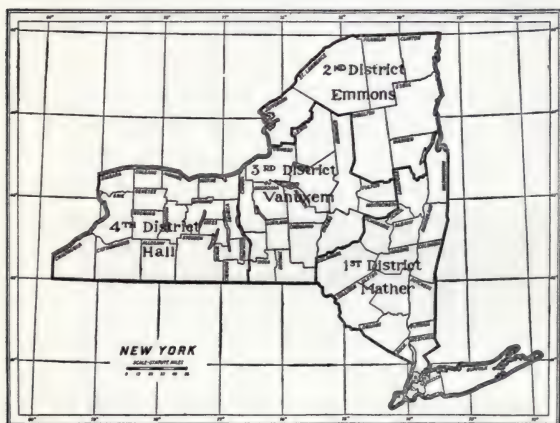
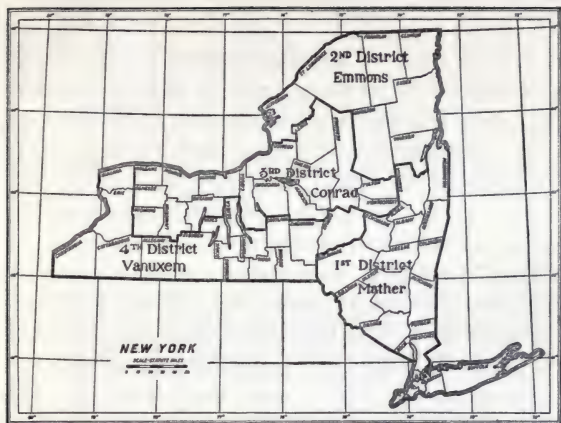
In 1836, eighty-five years ago, the active operations of the Survey began,⁵ and Mr. Hall started work in the Adirondack counties.

As his chief Dr. Emmons had first to reconnoiter the entire rugged district and to traverse the mountain wilderness by trail, canoe, and camp, he detailed Hall to a special investigation of the iron ores scattered broadcast throughout the region, the magnetites and hematites, which had long been recognized as important sources of natural wealth and had been worked by the pioneers when charcoal furnaces were used to smelt these refractory ores. Mr. Hall's study of these deposits was historical and descriptive, but not very technical nor specially adapted to the encouragement of development. He pointed out their vast extent and

⁵ The results of the Survey were so eagerly awaited by the people that their expectations were embarrassing. Henry D. Rogers writes to his brother William B., the Geologist of Virginia, as early even as 1836: "The New York Survey is ruined by attending to the popular impatience. General Dix who drafted their plan, confessed to me in a letter how much the good of the measure has been marred by it, and this is the secret of their great appropriation, \$26,000 per annum." To rush it through! (Life and Letters of William B. Rogers. Vol. I, p. 131.)

their promise whenever their difficult technology was compassed. But with all his vision he could not foresee the existence in the ore bodies of the eastern and northern Adirondacks, of a billion tons of magnetite, much of which is still abiding its time for the advantage of posterity. This report of Hall's was a very important part, nearly one-half, of Emmons's report on his first year's work. Curiously, his early personal acquaintance with these iron ores did not protect him from disaster among them. Gravely consulted many years later as an authority by an organized company of sharpers, who had secured a cloudy option on a well magnetized and alluring but thoroughly buried ore proposition, he was induced to invest his money in the project. At that time he had just sold his great private collection of fossils to the newly organized American Museum of Natural History. About one-half of the generous sum he obtained for it, Mr. Hall, with characteristic confidence, immediately sunk in this mining scheme; much, no doubt, to the ecstasy of its promoters.

By the close of the first season it had become manifest to the Board that the division between the Third and Fourth Districts of the State was not logical, and they recommended that the boundaries of the two be changed by dividing them along a north and south line, which should be practically the meridian of Cayuga Lake, from Lake Ontario



The Four Districts: Divisions of 1836 above, of 1837 below.

to Pennsylvania. This arrangement was approved by Governor Marcy and gave to each of the two districts a full and equal series of the rock formations. Meanwhile, Mr. Conrad had not made much headway in his field. The work was not to his liking; he had from the start wished to give his entire attention to the determination of the fossils already coming in with great abundance, and as his attitude was in exact accordance with the wishes of the rest of the Board, Mr. Conrad retired as Geologist and was appointed Palaeontologist; whereupon Mr. Hall was designated by the Governor as Chief Geologist of the new Fourth District.

CHAPTER IV

THE FOURTH DISTRICT, 1837-1843

Character of the Region—Abundance of Fossils—Early records of them—Phelps and Gorham Purchase—Robert Morris's interests—Holland Purchase—New England Settlers—Lowlands, uplands, rivers, and lakes—Genesee river section—Hall discovers Eben N. Horsford—Sends him to the Rensselaer School—Hornby Lodge and the Hall Memorial at Genesee Falls—Horsford, Boyd, and Carr, assistants in the uplands—Hall at Gorham and Naples—Anxiety over Coal—Writes to H. D. Rogers and Rogers's reply—The Coal problem settled—Old Red Sandstone—Results of Survey—Hall's philosophical opinions—His "Preliminary Considerations"—Agassiz's comment.

THUS the season of 1837 brought Mr. Hall to the opening door of his entire career. His new and great field of labor covered ten thousand square miles, contained the simplest, most lucid and most complete development of one great geological system, the Devonian, that the world has ever revealed, and a very important though abnormal presentation of what we now include in the Silurian system. The rocks of the country overflowed with fossils, often in beautiful preservation. They showed themselves in the stone fences and farm foundations; they lay loose along the streams

and on the shores of the Finger Lakes; and they protruded from the rocks on the edges of the cliffs. So ubiquitous were they that the Seneca Indians used the fossil cup corals for pipes, strung together the joints of crinoid stems into necklaces, and buried brachiopod shells along with axes and spear points in the graves of their braves. They attracted the attention of the early explorers, for Maude, the English traveler, sets down in his journal written at Canandaigua in 1800, that "Mr. [Nathaniel] Gorham¹ showed me a petrified wasp's nest found in digging a well; it was incorporated with a piece of winstone" — a coral in the Hamilton shale; and Alexander Wilson, the ornithologist, on his pedestrian bird-hunting trip in 1804 from Philadelphia to Niagara Falls, saw "marine shells" in great numbers in the rocks of Seneca Lake. In this region, where neither stratigraphy nor structure actually presented any obvious difficulties of interpretation, it is little wonder that the fossils excited Hall's keenest enthusiasm. Looking back now from this rather remote present, it is easy to see that Hall, who had not been inspired by the rocks of Hingham nor greatly impressed by the iron mines of the First District, was revived by coming into contact with the relics of organic life which reached back from the rocks of the Fourth

¹ The son of the pioneer referred to below and stationed in this frontier country to represent his father's interests. He died in 1826.

District to the tide pools and inlets of Hingham Harbor.

This district survey was for another reason an interesting adventure. Its territory was practically that of the original "Phelps and Gorham Purchase." It had belonged to Massachusetts who claimed fee under her patent in all the land west of what had become known as the "Preemption Line," a vagarious boundary supposed to be the western limit of the Bounty lands given by the State of New York to its Revolutionary soldiers. This line ran eventually a little east of Seneca Lake; that is, a few miles within the actual east boundary of the Fourth District. The State of Massachusetts sold her right to one million acres of these great lands, which was no more than a right to amicably extinguish the Indian title, to Oliver Phelps and Nathaniel Gorham, enterprising citizens of Massachusetts, who thus became the proprietors of all this western domain which was soon to become famously known as the "Genesee Country." Phelps and Gorham, having opened a land office in this territory as early as 1789, sold off townships along the northern plain and somewhat into the southern upland; but meeting the fate of most land speculators of the time, they became financially embarrassed and disposed of the balance of their holdings to Robert Morris of Philadelphia. Thus Mr. Morris became the pro-

prietor of a large area of the country, and his family name is still preserved in the historic town of Mount Morris on the Genesee river. Mr. Morris, in his turn financially involved, deeded his holdings, after a few individual sales, to a company of London Associates; Sir William Pulteney (whose name and that of his daughter, the Countess of Bath, are still conserved amongst the place names), John Hornby and Patrick Colquhoun. The more westerly part of these lands, subsequently acquired by Mr. Morris, was eventually transferred to the Holland Land Company and constituted the patent known as the "Holland Purchase." The settlement of this country, however, was initiated by Phelps and Gorham, who sold townships to veterans of the Revolution and other fairly substantial citizens of Massachusetts and Connecticut. They had brought out among the fertile lands of the northern plain and its lower uplands a fine class of New England people and nearly all the present settlements of this part of the region had been established in stage days before the mule-power canal and the wood-burning locomotives had come to be active agents in perplexing the population.

These early villages were bits taken out of the Puritan atmosphere and set down in western New York. At the time of Hall's advent, the terraced plain bordering Lake Ontario, along which ran the canal and the railroads, was already dotted

with these New England settlements. Rochester was a flouring center for the great Genesee wheat fields, still resting its other fame upon Sam Patch's jump over the Genesee Falls. Buffalo was a prosperous commercial community commanding the terminal of canal and railway. The villages about were of riper vintage: Canandaigua and Geneva dignified centers of education and refinement; and De Tocqueville had characterized the former as the loveliest in America. From the Ontario basin south, the rock formations rose in orderly succession, deeply mantled with various drift forms but trenched abundantly by the water courses. The Genesee river, flowing across the entire State from south to north, through wonderful rock gorges and over five impressive cataracts, gave a section of majestic completeness. The Finger Lakes, with rock-bound shores and infinite gullies entering them almost at right angles, afforded a hatchment of dip and strike sections. Only the broken plateau of the Southern Tier, then still timber-covered and today resistant to transportation, was difficult of access to the geologist's hammer.

This field was Hall's "patent," and it is right to say that his five years of work herein constituted the dominating influence of his career and gave birth to the most excellent piece of field work he ever did. Out of it beyond all question came the

promise and the impulse of his future extraordinary labors in the science of palaeontology.

It is hardly necessary to set down on these pages the results of Mr. Hall's survey. They challenged the admiration of his contemporaries and have gone into the permanent records of the science. The great volume of 700 pages, his final report of 1843, enshrines them.

Quite naturally the first of the young geologist's efforts were directed to the extraordinary traverse made by the Genesee river. It was of no small significance to his work and assistance to himself that here on the banks of a confluent of the Genesee, in the spring of 1837, he discovered a young fellow who was to become his right hand in this work, Eben N. Horsford. Hall was twenty-six and Horsford nineteen when the two came together in the valley. Mr. Horsford's father had gone out into the Genesee country as a missionary to the Seneca Indians. There he had made his home at Mount Morris, but finally, abandoning his missionary labors, had bought a farm near the village of Moscow. It was at the father's home in Moscow that the intimate relations between the two were established which were to last and grow closer throughout a long life.

Horsford had been out the year before surveying the new railroad line from Auburn to Canandaigua, but he had been brought up on the Devon-

ian shales which shed their fossils at every turn on farm and creek, and now chance and the new survey had brought to him a man who could answer all his questions about them. Hall warmed to this young man, but he was quick to perceive that Horsford did not know enough to be much help to him, and nothing would do but that Horsford should go at once to the Rensselaer School and get a training with Eaton. That the Genesee wheat crop was a failure that year and that Horsford had no money, should not be an obstacle; poverty had been none to Hall, and he happened to know that Professor Eaton was again planning a civil engineering course for the school;² so he writes a glowing letter to Eaton about the young but impecunious engineer which has an extraordinary effect. Eaton addresses Horsford at once, July 10, 1837: "My amiable and judicious friend Prof. Hall has given me an account of your qualifications and views which induce me to make this proposal as agent of the Institute. I will cause you to be furnished with a room, board and our best facilities for study and improvement as an equivalent as Assistant Professor in Civil Engineering, your department to be linear and perspective drawing. Please ponder this and the basis of our agreement; as agent I have

² In a letter of 1834, John Wright says that Prof. Eaton will at once make application to the legislature "for to create a branch of engineering and technology."

the right of nomination. On the receipt of your answer I shall nominate you as Assistant Professor of Engineering." So, within a few weeks after the two had met, Hall had whisked Horsford off to Troy. The young professor did not get quite all that Eaton promised him, and he complains to Hall in the early winter that "Prof." would not give him any firewood and he could not afford to buy any. But the year passed, and at its close Horsford, the professor, graduated as Horsford, the student. Meanwhile, Hall had spent his time in the district in traverses and reconnaissance so that with the opening of 1838 he was ready for real detailed work.

We have intimated that this Genesee valley was the open door to Hall's problems. The rich rock sections of the Erie Canal and its locks, and the already well studied problems of Niagara Falls, attracted him; but it was the Genesee valley, with its great falls at Rochester, at Portage, its impressive gorge between the "High Banks," and its complete trans-section of the State from Pennsylvania to Lake Ontario, that unlocked the geological history of western New York, and remains today and must ever remain not only a monument to Hall's transcription of the record but the wide-open leaves of the great Devonian book. Amid the forest trees on the west brink of the great gorge of the river at Portage there stood, in Hall's day, an

eight-sided rustic chateau built after the style of "John O'Groat's House" on the cliff at Duncansby Head, in Scotland, and known as "Hornby Lodge," bearing its Scotch proprietor's name. Just across the river, on a natural rock face, now within the limits of the State Reserve known as Letchworth Park, which embraces all the Portage cataracts, a tablet has been set in the wall to mark the geological service and the record here embodied.

JAMES HALL

State Geologist of New York

1836 — 1898

Established in This

Fourth Geological District

The Classification of a Large Part of The
New York System of Geological Formations

Which Gave Enduring Repute to the Geology of New York
This Gorge Exhibits the Typical Expression of Hall's

Portage Group

Whose Rocks Carry an Assemblage of Organic
Remains Most Widely Diffused Throughout the World

This Tablet Has Been Erected By

Charles D. Walcott, Secty., Smithsonian Institution

John J. Stevenson, Prof. Geology, N. Y. University

John C. Smock, Commissioner, Geological Survey of
New Jersey

Charles Schuchert, Prof. Geology, Yale University

John M. Clarke, N. Y. State Geologist

1908

Having found his efficient lieutenants, Horsford, Boyd and Carr, Hall started them off with canoes and tents through the Finger Lakes, Horsford reporting often and with infinite detail every movement, every exhilarating experience, of which there seems to have been no end. There were stories of the wonderment of the villagers and rustics over their mysterious business, and of great boxes of specimens that were being packed up in barns and village stores; mishaps to their gear; hilarious accounts of country shows; very serious affairs over red-cheeked girls; all interspersed among lists of names of fossils and all the minute observations necessary to accurate record. "You will find the trilobites," Horsford writes to Hall at Moscow, "*on the bureau*. Those *on the mantel* are from a locality near Patterson's. I beg you will look at the *Orthis circularis on the bed*. Affectionately, Your Pupil." Indeed they were all boys together, sharing their confidences as well as their high purposes.

It is fair to the memory of these assistants and not unjust to Hall to say that the large part of the field work through all the southern counties and in the lakes region was carried on by the lieutenants, and when the survey was over they had visited localities in the district which Hall had never seen. But Hall was the general, tying all their observations together into their broad co-ordinations,

wisely spending his time on the northern part of the field which was in much more direct touch with the concourse of commerce; the region of the Niagara plateau from the Falls to Rochester; the plateau over which ran the living thoroughfares of the community: highways, railroad, and canal. When he wished to get away from the field for uninterrupted thought and match together the accumulating notes, he was wont to find his refuge in a farm home at a village appropriately named Bethel,³ a restful spot not far back from the east shore of Canandaigua Lake. From there he makes an occasional detour about or across the lake to the dignified home of Captain Monteith, where he had found not merely a cordial Scotch hospitality, but in ravine and cliffs a paradise of fossils. The Monteith home still stands in the shadow of the shale cliffs and raised beaches, carpeted with its vineyards, and the names of its ravine and "point" are now imbedded in the geological nomenclature of the State.⁴

On one occasion the writer took Professor Hall for his first visit into the Naples valley at the south end of Canan-

³ Bethel was then the name of the present village of Gorham. Soon after he is striving to secure a pension for the services of his Bethel host in the Mexican War, and it was from him that he first hears of Col. Ezekiel Jewett, one of Scott's veterans in Mexico, and to whom we shall have abundant occasion to refer.

⁴ "Menteth limestone." The spelling of the name has changed with the passing of the generations.

daigua Lake. He was then seventy-six years of age, and the purpose of the visit, in company with D. Dana Luther, was to show him the development of what has now been recognized as a very extraordinary display of life in the rocks of that region which had, in large measure, escaped observation. When Mr. Horsford entered this valley in 1838, he found a young schoolteacher of just his own age, a native of the place, interested in everything out of doors, and to him he appealed for guidance through the gullies and over the hills of the region. From the trips afoot through the rocks of Naples germinated still another friendship which lasted as long as life. The young schoolmaster afterward became a student in chemistry under Horsford at Cambridge, and in the years of old age these men were wont to foregather either in Canandaigua, or at the old Temple Hill School at Geneseo, where Horsford got his early education. Of the three men, Horsford was the first to depart this life; Hall and the schoolmaster a few weeks apart. The schoolmaster was the writer's father.

After Horsford left the survey he became teacher of mathematics in the Albany "Female" Academy and there he remained a number of years, carrying on experimental work in chemistry which was the line of his closest interest. Some years were spent with Liebig in Giessen, and while he was away Hall instituted the effort which was to place him in the Rumford professorship at Cambridge. The writer has in his possession the correspondence carried on between Professor Hall and others, with reference to Horsford's promotion to this position. The effort was a tempestuous little affair in its day, in which Hall had secured the co-operation of Professor John W. Webster (an excellent but underpaid Harvard chemist, who, overmuch annoyed by an offensive note-shaver, cracked an unsympathetic skull with a geological hammer), and wherein Henry D. Rogers

was a zealous competitor. Horsford went to Cambridge in 1845, and his distinguished career is one of the assets of American science. It may be that in his later years, as he turned his interest to publications on early historical discoveries and gave to the philological world the first printed copy of Zeisberger's *Dictionary of the Iroquois Dialect*, his childhood interests and influences made themselves once more evident. In speaking thus of Professor Horsford in association with the Genesee valley and the Geological Survey, one can not help recalling the fact that another geologist of greater distinction in this science than Horsford, made his debut on earth at Mount Morris; Major John W. Powell, Director of the United States Geological Survey; and he, too, in later years, turned his attention to problems of aboriginal ethnology.

In the counties along the Pennsylvania border the quest for *Coal* was keen; organized companies were spending money freely on it, and like all adventurers in mining, wanted the assurance of success, with or without reason. The geologists were fairly embarrassed by the situation. Doctor Carr had been assigned to these sections, and his letters are filled not only with his observations but with anxious relations of the coal promoters and the appeal they were threatening to make to Governor Marcy for special aid to their projects. Following Carr, Hall traced the strata south from Allegany and Cattaraugus counties into Pennsylvania, had connected them up, he thought, with the coals of Blossburg, Penna., and he was quite

disposed to believe that coal might be found in these New York counties by penetrating the high conglomerates. In his anxious doubt he writes his first letter to Henry D. Rogers, who was then actively prosecuting the survey of Pennsylvania.

This exchange over a subject of great moment constituted the introduction of the State Geologist of New York to the State Geologist of Pennsylvania — it broke the ice, but the placid water soon froze over. The letters are of sufficient importance to introduce here.

GORHAM, October 22, 1839.

DEAR SIR:

I hope the subject on which I write will be a sufficient apology for introducing myself to you in this manner. I have much desired a conference with you on the subject of the geology of the country bordering the line of Pennsylvania and New York. I have found it necessary to extend my examinations within your State before I could find a terminating point upwards to my groups.

I have heretofore considered our rocks all below the rocks of the Coal series, but from late examinations I am convinced that one of the members of that series extends into this State and I mean the conglomerate. In the eastern part of my district, Chemung and Steuben counties, I find none of this rock, but in following up the Tioga River I find it overlying the Coal at Blossburg. In Allegany Co., at two points which are at least 1000 feet higher than the Tioga at the state line I find the conglomerate. Also in Cattaraugus co., at about the same elevation. I find at some depth below this conglomerate a thin stratum of red sandstone containing some of the fossils of the red

sandstone farther east. Immediately below the conglomerate there is a considerable thickness of rock which thus far I have found no opportunity of seeing, as the area covered by the conglomerate in New York is small and in elevated and uncultivated districts. There are some gentlemen in Cattaraugus co. who are anxious that borings be made from the conglomerate downwards. I shall present this subject to the other gentlemen engaged in the survey at our meeting on the 15th of November. In the meantime, if you will have the goodness to give me your opinion on the subject or upon the work in question, I shall feel highly gratified. I might state that the situations where the conglomerate is seen are bordering on the Pennsylvania line and south of Olean, extending beyond it.

Please address me at Albany.

Very truly

Your obedient servant,

JAMES HALL.

PHILADELPHIA, November 6, 1839.

DEAR SIR:

Your favor of the 23rd October arriving during my absence from the city, I have been prevented until now acknowledging the pleasure I have received from your communication and from submitting my opinion upon the subject mentioned by you.

I am aware that in certain portions of our bituminous Coal region, for example in Lycoming co., a stratum of conglomerate overlies the lowermost coal seam or seams of the country. There is also a coarse sandstone occasionally acquiring the character of a conglomerate which holds a corresponding place in the Coal series of Blossburg. Nevertheless I am far from supposing that generally along the northern margin of the coal region the rock, so decidedly a

conglomerate in its composition, is to be found overlying any beds of workable coal. It is proper for me to observe, however, that I have not yet had an opportunity of visiting the northern portions of Potter and McKean Counties, nor have we yet succeeded in removing all ambiguity respecting the true relations of the lower coal seams to the conglomerates bordering the coal field. * * * If the conglomerates to which you refer as existing in Cattaraugus co. is, as I believe it to be from boulders which I have there seen, the rock with large and closely set quartz pebbles, then I am pretty sure that it will be in vain to look for coal beneath, or indeed, for good coal immediately upon it.

If the conglomerate, moreover, is in the lowest, pebbly rock of the series, then I deem it quite unlikely that boring will develop anything of interest as regards coal.

By this time next year I hope to be in possession of ample information respecting the geology of our northern frontier. In the mean while I shall be most happy to impart my views in reply to any queries you or your colleagues may favor me with, though I fear me from the very unsatisfactory tone of this letter, you may think it, at least in relation to the northern line, not very well worthy trouble.

With sentiments of much respect,

Yours truly,

HENRY D. ROGERS.

JAMES HALL, Esq.

Thus was settled for all time the question of the occurrence of coal in New York; that is, settled so far as geology and the geologists were concerned, but the people were incredulous. Sir Charles Lyell in 1841 says he heard complaints on all sides to the effect that the geologists having been unable to find

coal, decided no one else would ever be able to find any; and Lyell himself, after a visit to the black "Silurian" shales on the Normanskill below Albany, admits they might easily be mistaken for coal measures. Seventy-five years have passed, and I suppose coal is more often "discovered" in New York today than ever before.

The trips to Blossburg settled another question of importance. There in the red rocks below the coal were found the remains of the Old Red Sandstone fish *Holoptychius*, and another, which a memorandum of 1839, in his own handwriting, says "Mr. Hall proposed to name *Heterolepis* (*Sauritolepis*) *Taylori*, in honor of Mr. R. C. Taylor⁵ of Philadelphia, who was the first person to suggest that the sandstone of Blossburg was identical in age and place with the Old Red Sandstone of Europe;" though Hall himself afterward loyally declared that Eaton deserved prior credit for the determination. "This [rock]," he continues,

⁵ Richard C. Taylor, an eminent English mining engineer, who passed much of his active life in America and was the writer of a well known book, "Statistics of Coal," became in 1841 a sort of unofficial free-lance assistant on the New York Survey. Before me lies his field notebook stamped "New York Geological Survey, 1841," the standard form of book used by the Survey, but the only copy I have ever seen, which by singular chance came to me from the wreckage of the Johnstown, Penna., flood of 1889. It is filled with beautifully executed sketches in water colors, some of rock sections long since lost to observation, and several of these were published in the reports of Vanuxem and Hall.

"should be considered a very important one as being the mass which separates the Silurian rocks from the Carboniferous formation which has not heretofore been recognized with sufficient accuracy in the country."

Assuredly these were momentous demonstrations to establish in a few months of work: the certain absence of coal in New York; the presence and base of the Carboniferous System in America; the existence here of the Old Red Sandstone of Great Britain; over against which the inclusion of the entire Devonian System in the "Silurian" stands in a startling contrast, indicating what a struggle Hall was having with Sir Roderick Murchison's early ideas of his "Silurian System;" a grip which manifested itself throughout his writings for years after and from which he loosed himself with obvious reluctance.

Different categories of geological results flowed from the work on the Fourth District. The stratigraphic determination of the New York Series of Geological Formations may stand perhaps as the most enduring pedestal of this monument which Hall helped to rear, for in spite of all the changes of the years and in the face of all the progress of the science, nothing has disturbed its solidarity, and the occasional younger ambitious geologist, out for a tilt against this obelisk, has too often turned back with a broken spear. Without minimizing

the great work of Hall's colleagues on the Survey in proving the integrity of the classification of the formations, he must be credited with its lucid demonstration from the rocks of this District. Others have builded, but the foundations are not to be altered. It is interesting, however, to note here in passing that Hall, in his general canvass of this classification, says specifically that he is making no reference to rocks there which "lie below the Taconic system," thus tacitly or temporarily assenting to the claims which Doctor Emmons in the Northern District was setting forth for the existence of a system more ancient than any recognized by his colleagues.

The study of these fossiliferous strata aroused in a singularly interesting way the philosophical side of Professor Hall's mind. Louis Agassiz, writing after he had arrived in this country and had received a copy of the Fourth District Report, tells Hall that he is "a visionary and an enthusiast;" and it seems quite likely that Professor Agassiz's opinion may have been based on some of Hall's reflections in which occur passages, set forth in his "Preliminary Considerations" to this volume, such as the following: "At the time our strata began to be studied, the doctrine of total destructions and renovations [of life] was generally admitted; the termination of every geological period was supposed to be marked by the annihila-

tion of every living thing and the commencement of the next one as distinctly by a new and entirely different creation. Further observation has tended to the abandonment of this doctrine; and so far as our knowledge now goes, *there seems to have been a gradual change from the first period of living things to the present time.*" This very extraordinary expression, not only precocious but venturesome, may well have called forth Professor Agassiz's exclamation, for it was very much in advance of the position then taken by the confessed leaders in science, and as is well known, Agassiz himself never accepted any views which implied continuity in such changes.⁶

There are other paragraphs in these "Preliminary Considerations" which are not only dignified in measure but in their philosophy; and of them Augustus A. Gould, the scholarly and critical naturalist, writes: "I have read them with great delight. I thought I would read a page or so before going to bed, when it was very late and I very tired, but I became so drawn in by the grandeur of the subject and the fascination of the style that

⁶ This frank avowal of organic continuity and derivation might be construed as a happy picture of future philosophical labors in his chosen field, and the challenge was, in 1843, all the more daring because Hall in 1838, directly upon his marriage, had joined the Catholic church. The fact is that he did not in after life follow the promise of this early thesis or ever permit himself to revel in the evidences of life-lines which swarmed about him.

I could find no stopping place." And Count De Verneuil, the admirable French geologist, already feeling a constraint toward America, writes from Paris: "I see by your 'Conclusions' that you admit the idea of a succession of beings upon the surface of the globe by way of new developments. This is after all most conformable to observed facts. Monsieur de Blainville, who is now giving lectures on Palaeontology in Paris, supports a very different theory. According to him, the fossil species only fill the chasms between living species. In the beginning of things all species were created complete, both the actually living and the now fossil species. He compares the scheme to a tree which has lost some of its leaves. M. de Blainville, with all his immense knowledge, has never made practical geology or palaeontology a study in the field."

The mere comparison suggested brings out the vitality and force of these "Considerations":

The doctrine of violent catastrophes and of sudden changes in the inhabitants of the ocean, was based upon the examination of limited districts, where the entire series of deposits had never existed, or had been subsequently obliterated. And gradual and tranquil as the changes now seem to us, they may appear infinitely more so when a perfect sequence among the strata of the whole globe shall become known; when a complete succession shall be established from the oldest to the newest rock. From what we now know, compared with the knowledge existing a few years since,

we can readily infer that some distant places, or even nearer localities, may furnish links now wanting in the chain.

In learning to regard nature as always the same, and her laws unchanging, we have made a grand step towards the explication of phenomena before unexplained except through a suspension of the natural laws or a miraculous interposition of creative power. Nature is always perfect and unvarying, but man's knowledge is progressive; consequently in every advance he arrives nearer to the truth, and yet as far from knowing all nature and her laws as he is from Infinity.

The knowledge of mankind, therefore, at one age seems but as folly or ignorance in a succeeding one; and it is the same regarding our own knowledge at different periods. Still there are certain principles which never fail, and which man through his whole life and mankind throughout all ages have acknowledged as fixed and unalterable. It is not the facts of observation that change, but the inferences which we draw from them as our knowledge becomes more extended and facts before unknown are added to the stock.

Viewing nature and the mind of man in this light, we are not to look at the imperfections in the works of those who preceded us but to be satisfied to add a few more facts to the great store of exact knowledge. We are to consider always that theories and systems are merely an exposition of the present amount of knowledge on the subject; and that *science* is the term used by philosophers to designate the conclusions drawn from a systematic arrangement of facts, verified by other facts, relating to any portion of nature's works; not in the least signifying that man's knowledge is perfect in any department of nature, or that science is less susceptible of improvement by the addition of new discoveries.

CHAPTER V

1

OTHER ACTIVITIES OF THE SURVEY PERIOD

Collections and collectors — The "Lockport Company" — "Hall and Slade" — Koch's "Missourium" — Caleb Briggs — Investments in Ohio lands — First foreign recognition — Trip through the Central States — Discovery of John Newberry.

THUS we have given many pages and might well give more, to the consideration of this pioneer scientific survey of western New York. It has justified them; to enter on an analysis of its results, however, would lead too far away from the purposes of this book. It was of course the principal business of the years from 1836 to 1843, but its activities could not exclude other concerns. The geologists were not earning enough to make them independent; \$1,500 a year was no great sum for a young man already well in debt, and as Hall scanned the horizon for some favorable sign of other income there was nothing in sight. So he turned with unremitting diligence to the building up of his scientific collections, and in these activities he required no other suggestions than the impulses of a man now consecrated to science and who must have the means of carrying on his work. The letters of ten years are evidences of incessant operations in collection building; buying, selling,

dickering, haggling over prices and debating of results. In those days the whole squad of natural history students were collectors; and though but a squad, its members made up in enthusiasm and diligence what they lacked in numbers. It was the day of the building of great private collections, and a student of natural science not fortified by a collection of his own making was a sort of foot-loose socialist with little to tie to. Silliman and Gibbs and Shepard were setting the example; Agassiz was soon to come, and no one of those days was his equal in scientific acquisitiveness. While at home in Hingham, in 1835, Hall had to walk to Boston to hear the greater Silliman give the Lowell Institute lectures, but his first personal contact with this man who was to befriend and encourage him, came about through answering an advertisement for minerals for Yale College printed in "Silliman's Journal." And these two hack and whittle over values like gentlemen and part friends. Hall set his lines in every direction. We find Sager sending on collections from Michigan by Bela Hubbard;¹

¹ Bela Hubbard was Houghton's assistant on the Geological Survey of Michigan. He "came to Michigan a youth, in the spring of 1835, and settled in the town of Springwells, two miles from the western limits of Detroit, then a city of less than 5,000 inhabitants. On or near the spot of his first abode upon the banks of our noble river, he has dwelt for half a century, until the spreading city has absorbed the intervening farms." (Hubbard's "Memorials of a Half-Century," 1884). Mr. Hubbard was extraordinarily versatile in his scientific interests and an honored citizen of his commonwealth.

Silurian fossils coming in from the early collectors in and about Cincinnati, Dr. John Locke, Dr. Clapp, Carley, David Christy, Joseph Clark; minerals and fossils from C. M. Wheatley of Phoenixville, and Dexter Marsh the "father" of the Connecticut Valley fossil "bird tracks," and from a dozen enthusiasts in New York, mostly of his own making.² Indeed, so far did Hall's zest lead him, that he organized a little joint stock company to mine the canal banks at Lockport for trilobites and other things, with Carr and John Newberry as shareholders. A part of the procedure of this company seems to have been to extend its sphere of control over certain splendid specimens of trilobites which were in the possession of local collectors, among whom was a Mr. Marsh, father of the distinguished palaeontologist, Professor Othniel C. Marsh of Yale University. It is recorded that Marsh would not part with his fossils. John Newberry, alive with zeal but short of money, was never able to turn in his share of the capital stock, and laments to Hall in sackcloth and ashes, hoping forgiveness for his dereliction; but he had "actually spent less than \$20 in cash that year in college."

² Hiram Murdock, a Quaker farmer at Gouverneur, whom he had interested in minerals, sends down a box of calcites "with the ardent prayer" that "thee will not lose sight of the Pearl of Great Price"; and a cloth-weaver and fuller at Hoosick Four Corners, whom Hall had inspired by his lectures on chemistry, for years kept him supplied with suitings in exchange for minerals.

He gets his indulgence, for Hall sees to it that he receives his share of the dividends; which, Newberry complains, are mostly broken brachiopods and pieces of trilobites!

Another of these interesting partnerships in the business of fossil hunting went by the name of "Hall and Slade." In this undertaking Hall furnished the money and staged Israel Slade, a graduate of the Rensselaer School living in Pittstown, Rensselaer county, with a two-horse team and a wagonful of oats. Slade, with his wife, his son, and Hall's younger brother William, drove first to Carbondale, Penna., to collect coal plants and to reassure Hall that the coal beds do not extend into New York. From there, as the cold weather came on, he drove to Philadelphia with letters to Doctor Samuel G. Morton and Conrad; thence to Baltimore for directions from Doctor Ducatel, and so on up the Roanoke river to Salem, Va., after Tertiary fossils. By January he is in Camden, S. Car., and has visited all the mines in search for minerals and sought out all the fossil localities. Thence he goes to Sandersville, Ga., and by April has made tremendous collections in the Claiborne, Ala., Tertiaries. Here he runs across Doctor Koch, who had already acquired notoriety and money out of his misshapen mastodon or "Missourium" which he had exhibited in the East and then sold to the British Museum "for \$10,000,"

as he tells Slade; and Koch was here at Claiborne getting out the materials for his astonishing and inscrutable "*Hydrarchos*," which, dragging Professor Silliman in its train (*Hydrarchos Sillimani*), was soon to distend the eyes of the Boston naturalists. Slade declares that he himself found these specimens, and that Koch bribed his men on Judge Creagh's plantation to let him have them. It seems that there were two of these skeletons in the rocks, ancient whales (*Zeuglodon*) as they proved to be, and old Koch got both of them away from Slade. And it is well known that he managed to match the two together and make one "*Hydrarchos*" 114 feet long, to the great scandal of the firm of "Hall and Slade."

By early summer Slade is in Tennessee with letters to Doctor Gerard Troost, one of the survivors of that extraordinary coterie of scientific men dispersed from Robert Owen's socialistic colony at New Harmony (Maclure, Say, Lesueur,³ Richard and Dale Owen), whom he found to be "an obstinate old Dutchman" when it came to the

³ Lesueur was a student of Cuvier, and I think New York Palaeontology may now confess the measure of its debt to him. Early in 1820 Lesueur visited Albany at the request of the State Boundary Commission and here he was quickly found by Eaton, then lecturing at the Troy Lyceum. Forthwith he was whisked off, as opportunity presented, into the Helderbergs whose teeming fossils were lying nameless. There Cuvierian eyes and Cuvierian training helped Eaton, the Yankee geologist, to Cuvierian names, the first these fossils ever had.

business of securing fossils; but on the whole the collecting venture was a very successful one.⁴

In these days, too, came Caleb Briggs, Jr., a Rensselaer School graduate who was to contribute in no small way to Hall's solitudes as well as to his purposes. Lieutenant Mather, by permission of Governor Marcy, had been released from New York for a portion of each year to organize and conduct a Geological Survey of Ohio, where he was at home; and he had taken Briggs along for his assistant. The young man saw in the undeveloped and unallotted Ohio lands visions of great wealth, and he arranged a triangular combination by which he, Mather and Hall were to buy into these lands under congressional sale, severally, but hold their titles for a while jointly. Into this project Hall entered. Thus they acquired and took up options on several thousand acres of land believed to be of fabulous iron and coal values, on the Cuyahoga river not far from Cuyahoga Falls. They bought and they sold and they bought again. Through ten years Briggs's letters are of unpaid notes, of projected railroads, of interest due, of visions of coal

⁴ Slade was not without experience as a geologist and had been for a while on the Virginia Survey with W. B. Rogers. Mr. Hall afterwards acknowledges his obligations to Slade for the limits of certain of the Virginia formations as shown in his map of the Middle and Western States.

mines fully running and feeding their product to iron smelters whose chimney stacks he could trace with his pen point.

Mather had started out to take title to all these lands, accepting from the other partners all sorts of unsecured notes, liens, and promises to pay, and when he was prepared to turn over the individual titles he proposed that he divide the parcels according to his own judgment, put the blank deeds in a hat and let Dr. Emmons draw for each party of interest. Somehow this proposal did not make a very profound appeal to Hall and we are of the impression that it never went through. But the outcome of it all was this: Briggs started the project in 1837; soon after he left Ohio and joined William B. Rogers on the Geological Survey of Virginia, and in that capacity had an informal connection with the University of Virginia. The Ohio lands were hanging over them like the sword of Damocles, and Hall, once more hard-pressed for money, begs Briggs to induce Professor Rogers to buy his entire collection for the University. Rogers was tempted, and Hall promptly withdrew his offer; just as he did later when after years of pleading with Agassiz to take his enormous collections for the new Museum of Comparative Zoology at Cambridge, and when Professor Agassiz had found the money, Hall refused to part with his

materials largely for the reason that he simply could not carry on his work without them. So Hall kept his Ohio lands for nearly twenty years, until there came a time when his beloved science was in danger of running on the shoals because the legislature of New York refused to make provision for it. Then he sold at once, at market price, so that he might, as he did, turn the money into his work, into paying salaries of assistants and field expenses, for collections and artists, thus carrying on his own broad shoulders the load which by right and of honor belonged to the people of the State of New York.

How many men today in official place would, without crying out, so open a pocketbook, lean at the very best, to the achievement of an ideal? It was an honorable sacrifice, one that tells of highest singleness of purpose; and it is one of a sort that the scientific servants of the Empire State must accustom themselves to without wincing.

In 1837, just after entering upon his new command in his own District, Mr. Hall received his first notable recognition from a learned society — a diploma of membership in the Imperial Mineralogical Society of St. Petersburg, that ancient organization which has ever sought out the young man and made it its eminent purpose to encourage evidences of scientific promise. It must have been

a grateful tribute in the eyes of the young Hall, as it has been to many another since, for perhaps in all the world of scientific organizations none has done so much to help by its distinguished recognition the upward glances of the devoted scientific youth. So much at least this body, changed in title after the fall of the empire, and now crushed and bleeding under the juggernaut of communism, had to its very great credit.

The work of the Geological Survey was practically done by 1841 although the reports were not printed until 1842 and 1843. It is probable that Hall put some finishing touches to his pages after the season of 1840, especially, as we show presently, his account of the geological history of Niagara Falls. But of all the four Geologists he was by much the most interested in seeing how far the classification of the New York Formations held true beyond the boundaries of New York State. His view of the problems was broad, his conviction as to the worth of the Survey results was deep, and had he not promptly determined to extend their application so far as practicable beyond the boundaries of the State, it seems likely that the competitions of time and the local surveys of other States might have invaded or impaired the New York classification. Therefore, at the earliest

opportunity, in the spring of 1841, Hall left his work in New York and joined David Dale Owen⁵ on a trip down the Ohio river, sailing, to use his own words, "on a flat boat, sleeping on a box, and collecting fossils all along from Louisville to New Harmony." Tying up his boat at various mud ports along the river, he made side trips and detours in many directions, and indeed, on this trip he traversed more than 4,000 miles in the States of Ohio, Indiana, Illinois, parts of Michigan, Kentucky, Wisconsin, Missouri and Iowa. It was an enormous area to cover in a two months trip but it gave him just the data he needed for the extension of the New York classification over all this region, and not many weeks after his return he had written out his observations and conclusions and by the first of September they were sent in for publication to the *American Journal of Science*.⁶

His determinations were not too late for his New York Report, and he incorporated them by introducing in it a "Geological Map of the Middle and Western States," in which he combined not only his own observations and those of his colleagues in

⁵ Dr. Owen, son of the founder of the colony at New Harmony, was the most experienced and the most learned of the western geologists. He had been busied with the rocks of the Mississippi Valley since 1834, sometimes alone, sometimes as government geologist and sometimes with his colleagues Troost of Tennessee and Locke of Ohio.

⁶ Volume 42, 1842.

New York but those he had acquired on his western trip as well as data from his official colleagues in Pennsylvania, Maryland, and Virginia. This map had as its distinctive purpose to show the distribution of the New York formations outside the boundaries of New York. It established a strong and proper precedent for doing in future years what has now so often been done by the State of New York, namely, to pursue and describe the New York geological formations beyond their artificial geographic boundaries.

On this trip through the West an incident of unexpected interest occurred. Hall had never seen his Ohio lands, so took the opportunity to go to Cuyahoga Falls and look them over. He had taken the first steamer of the season out of Buffalo to Cleveland and thus made his way to his estate. His business took him to the farm of Henry Newberry, and there he became much interested in Mr. Newberry's son John, to whom we have already referred. Hall has told about this meeting.⁷

Newberry was a keen-witted youth, interested in all branches of science, and it seemed as though it were the influence of just such a man as Hall that was needed to guide the young man's activities. Hall says:

⁷ In a letter printed as a part of the memorial of John Strong Newberry prepared by Professor John J. Stevenson for publication in the *American Geologist*, July 1893, p. 14.

"I found him a most amiable and intelligent young man, deeply interested in natural history and conversant with the geology of his neighborhood, having acquired a great deal of knowledge from the study of the rocks in his father's coal mines and otherwise well acquainted with the interesting localities within the State. * * * He has often said to me that my coming to Cuyahoga Falls, fresh from the field of New York geology, opened his eyes to things which had not before attracted his attention and decided him to devote himself to geological science. * * * Dr. Newberry was at that time a young man about nineteen years old while I was in my thirtieth year. * * * Before we parted we had become fast friends initiating a friendship which continued uninterruptedly for more than fifty years."

Doctor Newberry's efficient subsequent career, not alone as a discoverer and teacher in geology but in the eminent medical service he rendered to the United States Sanitary Commission during the Civil War, brought distinction alike to pupil and patron.



JAMES HALL

1843

(From a daguerreotype)

THE BOARD OF GEOLOGISTS

Classification — Major Units — Taconic System — Association of American Geologists — Geologists and Naturalists — American Association for the Advancement of Science — Commemorative tablet.

IF the theme of this book compels us to single out one man for eminent consideration, in so doing it is not desired to obscure in any way the distinguished merits of his official colleagues. All rendered superior service and they held each other in mutual confidence and respect. It was the duty of the Board of Geologists to pass upon the weightier matters of classification of the rock formations and to match together discrepancies, apparent or real, among the different districts. In one important matter they were united, and I believe this action was in large measure due to the influence of Eaton, direct and transmitted; the erection of a series of unit formations bearing either distinctive New York local names or designations derived from their rock or fossil characters; these grouped together by local terms of larger meaning and finally all put into a primary category of major divisions, Champlain, Ontario, Mohawk, Helderberg, Erie, and Catskill, which from below upward embraced all the lesser divi-

sions. The Geologists adopted the practise of employing New York names alone, and were loyal to it; and while this may be taken as an evidence of their independence from European influence, it expressed also their conviction that here was geology that must be taken as an American standard. Their own use of these names was, however, not uniform, and Hall wrote to Lyell in 1842 that he did not care for these larger divisional terms. The entire scheme was used by them with some freedom and some individual differences. Correlation with the English divisional terms was vague, and even as late as 1842, Hall and Lyell were speaking of the "Silurian" rocks of Moscow, N. Y., and their fossils, a horizon far up in the Devonian formation. Here again is evidence of the influence which nearly got control of Hall, who had come to understand his fossils rather better than his colleagues; that of the claims which Sir Roderick Murchison was strenuously enforcing in England with all his powerful influence, on behalf of his "Silurian" as against the "Cambrian" of Sedgwick; a controversy which arose over the attempt to define a geological system as a conception rather than as a delimited unit determined by slow invasion and recessions of the sea and its faunas.

It seems to us now much to be regretted that the major divisional units proposed by the New York men and referred to above were not at once sub-

stantiated by use, for time has shown that they carried a more exact expression of the natural grouping of the palaeozoic formations of interior America than do the European names which usage has imposed, and in some measure they have a juster claim to admission. As Hall, who alone was to continue official geological work in New York, himself soon abandoned these major terms, their displacement was made effective at a later date when James D. Dana excluded them wholly from his "*Manual of Geology*," a book which at once became and continued the most influential standardizing factor of the science in this country.¹

There was another matter which the Board of Geologists considered in season and out of season and upon which they reached no unified conclusion. This was the troublesome proposition brought in by Doctor Emmons from the Second District, the Taconic System, which in his view was a great series of sedimentary rocks lying below the Potsdam sandstone and representing the opening chapter in the life history of the world. It was a confusing issue, and Emmons did actually discover in New York this earliest or "primordial" fauna, but this important determination was befogged by the involved and misinterpreted geology of the

¹ The geologists of the present New York Survey have endeavored to reinstate and redefine these major terms; an effort in which they have had the co-operation of Professor Schuchert of Yale.

Taconic System, and many subsequent references to it are forced in upon this history. The Board itself tacitly conceded the conception and let Doctor Emmons be entirely responsible for it. Lieutenant Mather admitted it, and Hall let it pass in his final report, and none of them realized that they were transmitting to posterity a venomous problem in American geology.

It is a very noteworthy fact, already casually referred to, that out of the deliberations and conscious needs of this Board of Geologists was born the germ of the American Association for the Advancement of Science. The history runs in this way: These annual meetings of the Board were held after each field season. Early in the year 1838, Lieutenant Mather, who had kept in correspondence with Professor Edward Hitchcock of Amherst, his predecessor in appointment for the First District, addressed a letter to the Board suggesting "the propriety of a meeting of the geologists and other scientific men of our country at some central point next fall, say New York or Philadelphia." In this letter he casually remarks that "such a meeting has been suggested by Professor Hitchcock."²

This matter was taken up for informal consideration at the meeting of 1838 held at the house

² See also letter from E. Hitchcock to H. D. Rogers, Apr. 4, 1838, as printed in *Life and Labors of William B. Rogers*.

of Doctor Ebenezer Emmons, at the corner of High Street and Hudson Avenue, Albany, and after discussion it was agreed to, and Mr. Vanuxem was authorized to open correspondence with the geologists of the country with reference to carrying this project into effect. There were present at this meeting Emmons, Mather, Vanuxem, and Hall; Conrad, James Eights, and perhaps one other of the field assistants, with Ebenezer Emmons, Jr.; and both he and Professor Hall have left an account of the incident.³

Professor Hall has said to me that the letters sent out by Vanuxem, especially to William B. and Henry D. Rogers, brought no result that year, but the following year so much encouragement was received from various geologists in the country that it was decided to call a meeting in Philadelphia for April, 1840. The meeting was held and the Association of American Geologists was organized. This Association met again in Philadelphia in 1841. Its third meeting was at Boston in 1842. At the Boston meeting the American Society of Natural-

³ Ebenezer Emmons, Jr., was the gifted son of Doctor Emmons, who had all the elements of a versatile genius. He was a very superior artist, the illustrator for many of the volumes of the Natural History and he was not without geological experience. During his entire life he was more or less directly concerned with the work of the Natural History Survey and when I joined it he was assigned to me as draftsman. Some of his most faithful and accurate work was done when he was past seventy. He died in 1908 at the age of eighty-seven years.

ists expressed a desire to join the geologists, and although the Boston meeting was called as the meeting of the Association of American Geologists, in the course of its sessions its name was changed to that of the Association of American Geologists and Naturalists. This organization continued its annual meetings until 1847, when its scope was widened and its title changed to take in all qualified men of science in the country, under the name of the American Association for the Advancement of Science.⁴

When Hall, as President of the American Association for the Advancement of Science, in 1856, gave his address of welcome at the meeting in the old Geological Hall at Albany, he made reminiscent reference to other meetings of the Board held after the field seasons of 1838 and 39:

⁴The birth of this great body of American men of science known as the American Association for the Advancement of Science, historically recorded above, is commemorated on a bronze plate attached to the Emmons house, Hudson avenue and High street, Albany, erected with the approval of the Association, and bearing the following inscription:

In this house, the home of
Doctor Ebenezer Emmons
The first formal efforts were made, in
1838 and 1839, toward the organization of the
Association of American Geologists
The parent body of the
American Association for the
Advancement of Science
By whose authority this tablet is erected.

"Before concluding I can not forbear calling your attention to the circumstance that we are now assembled under the same roof where our Association in embryo first met, and where the true hearts and kindly spirits of some among our departed colleagues first held counsel upon the question, then momentous, whether American scientific men could be prevailed upon to unite in a harmonious confraternity for the advancement of their cause.

"In yonder chamber, eighteen years ago, sat half a dozen men who had just returned from the arduous field-labors of the year, and were comparing their observations one with another, and each one communicating freely new facts and new conclusions, for the harmonious working of the whole in a single science. This labor over, the question of inviting other laborers in the same field of science, to join them in similar interchange of views, facts, and results, was discussed; on the one hand with sanguine hope, and on the other with timid doubt.

"A second year the same parties were assembled in the same room, and around the same table, when the subject was again discussed, and what had before appeared desirable now seemed a pressing necessity, and it was decided to take some action. The youngest member of that group, who felt himself too inexperienced to take any prominent part in these discussions, stands before you to advocate, not his own, but the merits of his colleagues; and though the birth of the Association was proclaimed in a sister city, we claim for our own city the inception of the Association of American Geologists, of which our present Association for the Advancement of Science is the legitimate heir."

HISTORICAL DEVELOPMENTS AND PERSONAL CONTACTS

European geologists in America — Schoepf, Maclure, Featherstonhaugh — Coming of Sir Charles Lyell — Reception by Hall — Their trip through New York — Visit to Niagara — Lyell's enthusiasm — The work of the Geologists — His farther travels — His lectures and Hall's assistance — Hall's misgivings over Lyell's intentions — The Newspaper attack — Restiveness among the geologists over Lyell — Hall regrets his action — Proposes to write a text-book of geology — Lyell's wide acquaintance with American geology.

THE volcanic outburst of reports from the Geological Surveys throughout the States from 1835 to 1845, years when the sovereign competency of the States was unchallenged and national consciousness was not yet fully awake, aroused wide interest in western Europe. We must stop to remind ourselves that geology was still a very young science just emerging from a nebula of hypotheses and contentious guess-work into an orderly and rapidly increasing array of concrete effect and cause. Its novelty, the tremendous sweep of its propositions and the romance of its buried treasures gave all its adventures wide popular appeal. English and French geologists were making rational progress in laying the foundations

of historical geology and with Italy and Switzerland were finding out the principles of dynamic geology.

The new-found developments from the western world were therefore of exciting interest, and as soon as the reports of the New York men were spread abroad there began an invasion of the country by European geologists who would compare the old world with the new and help to set the whole terraqueous globe in order. New York had been portrayed as an extraordinary panorama of the old geology, the palaeozoic history of the earth. Its terms had been made lucid and were defined with reasonable precision. Its system was individualized and not poured into an European mold. It had none of the sunrise-twilight-and-evening-star poesy with which Rogers had apostrophized the old rocks of Pennsylvania, and it had escaped the necessity of weighing, like the South Atlantic States, the Old World and New World divisions of Cretaceous and Tertiary. "London Clay" and "Bagshot Sand" did not enter into the catalogue of its anxieties.

Right after the Revolution the Hessian surgeon, Schoepf, having been discharged from military captivity by the American patriots, traveled extensively through the Appalachian States and wrote what would have been an illuminating account of their structure had it not been couched in a tongue

which the Anglo-Saxons of that day declined to know; so that his work was virtually lost until it had become a mere historical curiosity. William Maclure, in the first decade of the last century and soon after his arrival from England, had prepared at the cost of colossal labor, a geological map and description of the entire known territory of the public domain, but however it may be regarded as marking a brave start in geological cartography, its result was too intangible and too devoid of detail to arouse enthusiasm or to greatly advance the science. It stands as a memorial to the prowess of a man who contributed much to elevate American science. George W. Featherstonhaugh had come over from England, had engaged in a certain amount of geological exploration under Government auspices, and in 1831 had launched a geological magazine, *The Monthly American Journal of Geology*, published at Philadelphia and indorsed by the brilliant stars in the British geological galaxy: Murchison, Conybeare, Sedgwick, Buckland, and Greenough. Featherstonhaugh's attitude toward his American colleagues was "superior" and he became tremendously unpopular. His "Journal" showed the effect of this and was discontinued at the end of the first volume.¹

¹ Featherstonhaugh came to America a young man, and not long after landing rescued the daughter of James Duane Livingston,

The advent of Sir Charles Lyell to America just as the New York Survey was closing, was a different matter; he came to learn rather than to teach. It was as though the America-trained geologists had spread a tempting repast which distinguished Europeans would venture to taste, and there can be no doubt that Mr. Lyell's visit was of somewhat sensational, if reserved, interest to the learned centers of America. He came as a philosopher looking for more and more facts on which to expand his "*Principles of Geology*," already in its sixth edition. Indeed, Mr. Lyell had long roamed far and wide in search of the essentials of his science. He was a man of quick insight, large absorptive power and plastic mind. He was intensely active, sought and found contact with every

Chancellor of New York, from a runaway horse and, as a romantic sequel, married her. They established themselves at Duanesburg, not far from Albany, where he maintained a manorial home and during the period of his residence took an influential part in affairs, being closely associated with the Patroon Van Rensselaer in agricultural development and especially in the promulgation of the Albany and Schenectady Railway of which both were signatories to the original charter. He was a man of much learning and force but overbearing in his relations with his associates, and after he left Duanesburg he did not hesitate to attack General Van Rensselaer and Professor Eaton violently in his "*Journal*." His geological adventures in the Arkansas and Red River regions were carried on under government auspices after he left New York. He never returned to the manor, but tiring of America returned to England, was sent back here as British representative on the Boundary Commission, and died in Havre where he was serving his government in a diplomatic capacity.

geologist within reach, traveled enormous distances under varied, diverting and often troublesome experiences. His first trip to America lasted from July, 1841, to August, 1842. On all this voyage he was accompanied by his wife, and they together were watchful of, amused by, and measurably sympathetic with the phases of social and economic life which the new democracy revealed to them. What Mr. Lyell's part is, in this story of the life of James Hall and in the interpretation of New York geology, is indicated by a sheaf of letters beginning before he arrived in New York in August, 1841 and continuing for twenty-five years; letters which contain materials of biographical value and scientific interest to which there is no reference in the "Life and Letters of Sir Charles Lyell."²

² "By his sister-in-law, Mrs. Lyell" (1881). These volumes are composed of letters written by Lyell and of extracts from his journal; in other words, they are essentially autobiographical. Mr. Lyell was the most distinguished geologist who had ever touched these American shores. Already he had been President of the Geological Society of London, and had issued the first volume of his "Principles" as early as 1830. The first of these letters are written from his home at 16 *Hart Street*, a place where distinguished men of science were wont to resort and which Charles Darwin called his "morning house of call." Most of the rest are dated from his later home, 53 *Harley Street*. While Lyell was not regarded by his contemporaries as a particularly keen observer in the field, he was by common consent the leader in co-ordinating and philosophic thought. Darwin said that geology owed more to him than to any other man then living.

In one of these is the statement, made as he was sailing home from his first trip, that he had visited forty-three counties in the State of New York under the guidance of the geologists. There was not one member of the Geological Board who had had so broad an experience in his own State. Mr. Lyell's immediate destination as soon as he had landed in Boston and could escape from the embraces of the distinguished men waiting to receive him there and in New Haven, was Niagara Falls; and we find him, therefore, right in the first chapter of his "*Travels in North America*" and of his "*Letters*," getting to Niagara Falls by the shortest route. Lyell came on to Albany to meet Hall. One may well suspect that the young American geologist, who was just launching his craft, felt among the embraces of hospitality no little awe, mingled with a tremor of apprehension as to what would become of all his treasured data if he too freely unbosomed himself to this older and much experienced personage. Indeed, we shall see that a few months later Hall did become alarmed lest this gimlet-eyed Englishman had bored too deep into his penetralia. At once the two took the field; first into the graptolite-bearing shales of the Normanskill a few miles below Albany — and it was here that Lyell made the note that he was half inclined to sympathize with the New York citizens who insisted upon searching these ancient Silurian

black shales for coal. Then they made their way westward, stopping off at Little Falls, where the Mohawk river has deserted its ancient course and cut out the historic and picturesque rock gorge of the Mohawk river, displaying the contact of the Silurian with the crystalline tongue of the Adirondacks. A little farther on, at Frankfort, they struck to the south and followed the "Gulf" southward up to its summit at Cedarville, making a traverse of the "Upper Silurian"; from there to Rochester and to Lockport to inspect the great rock sections of the Silurian at the Falls of the Genesee river and in the locks of the Erie Canal. It was under the influence of these experiences then and later, for Mr. Lyell was frequently in New York after this time, that he "became convinced that we must turn to the New World if we wish to see in perfection the oldest monuments of the earth's history so far at least as relates to its earliest inhabitants. Certainly in no other country are these ancient strata developed on a grander scale or more plentifully charged with fossils; and as they are nearly horizontal, the order of their relative position is always clear and unequivocal." And so with glances at the Ridge Road along Lake Ontario, whose beach nature he recognizes, though he compares them to the osar of Sweden, and with a look at a recently found mastodon, they make their way to Niagara Falls toward which

they were carried "along at the rate of sixteen miles an hour on a railway often supported on piles [they were traveling over a railroad surveyed only a few years before by Eben N. Horsford], through large swamps covered with aquatic trees and shrubs or through forests with occasional clearings where orchards are planted by anticipation among the stumps before they have even had time to run up log houses."

The two men spent five days together at Niagara Falls. They were days for Lyell of dramatic experience and excited annotation. His quick apprehension caught the significance of the grander features and the meaning of the shell-bearing post-glacial sands above the rocks on Goat Island and in the Gorge walls, while Hall found an interpretation of the drift blocked valley at the whirlpool leading down to St. Davids; then together they determined the clues to the entirely modern activity and work of the river and its cataract. The wondrous records of work done, measurable in terms of the continuing working force, the stupendous simplicity of the great chronometer as it revealed itself to him, made a profound impression on the spiritual sense of the distinguished philosopher, and he closes the second chapter of his "Travels" with a paragraph whose sentiment has echoed from many another heart:

"The geologist may muse and speculate on these events until, filled with awe and admiration, he forgets the presence of the mighty cataract itself and no longer sees the rapid motion of its waters nor hears their sound as they fall into the deep abyss. But whenever his thoughts are recalled to the present, the tone of his mind, the sensations awakened in his soul, will be found to be in perfect harmony with the grandeur and beauty of the glorious scene which surrounds him."

Lyell had brought to Niagara a very remarkable bird's-eye sketch of the gorge and river made some years before by Robert Bakewell, Jr., and this with Hall's aid he colored geologically, used in his American lectures, reproduced in his books and it has become one of the classic pictures of the Falls. It was one of the things that alarmed Hall for the safety of his golden fleece, as we shall see.

From the Falls the two geologists traveled to "the large town of Buffalo," Williamsville, and LeRoy, to Geneseo and the Portage Falls where Hall's memorial now stands. Returning to Geneseo, Hall left Lyell, hastened back to Albany, and at once made preparation for his trigonometrical survey of the Niagara Falls which he completed in time for incorporation in his report, and which has served a highly important purpose in establishing the rate of retreat of the floor of the cataract. Lyell left by stage for Blossburg, Penna., traveling by way of Dansville and Bath, where he ventured to dissuade an adventurer from sinking a

costly shaft for coal but got a reply which leads him to the reflection that —

“ Every scientific man who discourages a favorite mining scheme must make up his mind to be as ill-received as the physician who gives an honest opinion that his patient’s disorder is incurable.”

From Bath to Corning and Blossburg, where he had the opportunity which Hall desired him to have, of seeing the relations of the coal to the New York rocks; thence, by way of “ Jefferson ” (Montour Falls), Geneva, and Auburn, he returned to Albany.

With pious thought, Hall at once took the distinguished geologist to Troy to call on Professor Eaton, then within a few months of the end of his life. The next trip was a mastodon hunt in the swamps about the Catskills. Then followed a tour through the Helderberg Mountains and over to Schoharie to see the Gebhards and their collections of fossils, the two little dreaming of the historic touch they were giving to a place that today echoes the hammer blows of savants and students — of Eaton and Agassiz, De Verneuil and Desor, Marcou and Logan, of Silliman and Dana, the Rogerses, Roemer and Barrois; scores of leaders and learners of the science, a continuing procession. The great plaza of palaeozoic cliffs which make the Helderberg escarpment of the “ Indian Ladder,” and which command the panorama of the

confluent Hudson and Mohawk valleys, is now a reserved public monument consecrated to its geology and to the memory of the men who have unfolded its history.³

Lyell found the Helderbergs in a ferment of excitement. The antifeudal "Helderberg War" was at its height and the leaseholders of the Patroon, Van Rensselaer, were in arms against his agents. The "embattled farmers" were shooting off guns in reckless fashion, killing sheriff's deputies and maiming the State militia, and this expiring outburst against emphyteutic leaseholds in America excited the traveler's keenest interest. Soon, however (September 27th), he left for New York, finding the river scenery "more beautiful than ever." His days with Hall had filled him with enthusiastic regard for the work done in New York and had laid the foundation of a deep personal attachment to Hall; Lyell was reserved, his lecture audiences in American cities found him "chilly" in Philadelphia, "distant" in New York, and "dull" in Boston, yet as soon as he reaches Philadelphia his concern in the New York work is

³ The "Indian Ladder" was acquired by the late John Boyd Thacher of Albany, a constructive citizen and historian of distinction, with the purpose of setting it apart as a public park and monument because of its geologic interest and scenic beauty. Mr. Thacher did not live to carry out his intentions but they have been made effective by his widow. The reservation is known as the *John Boyd Thacher Park*.

so keen that he writes Hall at once of his experiences with Conrad and Vanuxem whom he has visited, and a part of this letter may appropriately be inserted, the latter portion of it having even yet some concern to the classification of the New York rocks:

PHILADELPHIA, Oct. 1, 1842.

MY DEAR HALL:

* * * We reached this . in 2 days after leaving Albany, and I started without delay with Mr. Conrad to explore the Green Sand of New Jersey, on which in all I have spent three delightful days much struck with its close analogy with the cretaceous of Europe and have collected some forty species, five of which are new to Morton and Conrad. I have been much pleased with Conrad, and am sure that were he not left isolated and could have more frequent intercourse with congenial souls, he would no longer see difficulties or dwell so much on his constitutional maladies. I have got your one dollar from Mitchell's agent Mr. Barnes, but not the uncoloured map. I will pay it you when we meet. If you get the missing Geneseo champagne basket with specimens and send it by Beattay, agent of Boston packet office, will you learn from him whether he sent off the *seven* packages which I left at his office one evening in charge of his men after he had gone. Address the other packet to me, care of William Booth, Esq., Bowdoin Square, Boston.

We have been to Bristol and much pleased with Vanuxem's museum, and with that portion of the hall which connects him with the geological, and not the theological corps. He seems well inclined to adopt the terms Ontario, Niagara and Mohawk groups, and with a little persuasion perhaps will name everything from Tully limestone down to Manlius

shale Ludlowville. He now calls the Protean group the Clinton. I am glad to find Conrad think that *P. laevis* is the young of *Pentamerus oblongus*. From what I hear, I begin really to think that those six feet of Oriskany sandstone at Schoharie expand into seven hundred feet in Pennsylvania. Vanuxem and Conrad are much surprised at the idea of the Schoharie coralline limestone being the Schoharie, but if so V. thinks that the Pyritous shales must be his Clinton ferruginous. * * *.

Ever most truly

CHA. LYELL

The following letter, written several months later, shows his continuing interest in New York affairs and evinces his earnest purpose to be fair to all parties concerned in its geological problems, though it refers to some other matters of which we must presently take account:

MY DEAR HALL:

I was glad to hear from you again and if I had time could give you a good account of my Southern explorings in the newer formations. I saw all the bluffs on the Savannah River between the falls at Augusta and the sea, some parts of the interior of Georgia, 50 miles of the Santee R., S. Ca., the Wilmington district, N. C., the neighborhood of Petersburg and Richmond, Va., the tertiaries of the James River from Richmond to Williamsburg. My previous visits to the cretaceous formations of New Jersey were most useful.

Many thanks for your copy of your paper in Silliman which I have heard spoken of favorably both in Virginia

and here. I am very glad you came out with it. Conrad admits its merit though he is disposed to give some criticisms, one of which is that the *Catenipora* has been found by him in the Protean of Wayne County below the *Pentamerus oblongus*, as also in the Moscow beds.

I do not like to volunteer the communication of my individual opinion on the New York or any other Survey, as it would be putting myself too much forward. When appealed to I have always been glad to eulogize what I think so well done. I will not use your map without a previous understanding with Vanuxem and Conrad who after proper explanation will approve of what we did at Boston.

You remember that I read over to you a brief historical notice of what Rogers, Bakewell, Jun., Conrad and yourself had successively determined in the Niagara district, which you approved of, but I had entirely omitted all mention of Eaton. On my arrival here, before going south, Eaton's book on the Van Rensselaer canal was put into my hand and I was quite astonished on looking at the Section of the rocks at the Falls to see how correctly the formations were represented with their southerly dip, well grouped, showing the entire independence of the escarpment on any fault and referring in the text, the lower Ontario Sandstone, which I think he calls Saliferous, to the same age as the Sandstone of Medina, showing that he knew of its extension eastward. From the blundering way in which Mr. Ingraham had introduced into his Section what he represents as Eaton's views, I had no notion that the old veteran had got so far at so early a period. I had just time to write a letter which would arrive in London at the same time as my paper in which I gave for insertion a sentence or two about Eaton who has correctly represented all from the Rapids to Lewiston.

As to what they are going to do in Canada I have heard nothing and am too fully occupied with other plans to care much about inquiring. I have no reason to suppose it would be offered to me, nor if it were am I sure that I should best promote the good cause by undertaking it in preference to projected operations. It will be time enough to think of this when I am invited.⁴ * * *

Believe me, dear Hall,

Ever most ty yrs

CHA. LYELL

The new-found friends had not yet seen the last of each other on this first American visit by Lyell. Mr. Lyell pursued his geological tour from Albany to Philadelphia, into the Appalachians of Pennsylvania under Professor Rogers's guidance, returned to Boston in October to give the Lowell Institute lectures, for which purpose he had really come out from England. Hall went over to Boston to hear these; and among the letters of this juncture is one from Professor Silliman asking Hall

⁴ This intimation that Lyell was by any one or in any way being considered for the directorship of the proposed Geological Survey of Canada does not, so far as I know, appear in any other record. Just at this time the leaven of this organization was working, William Edmond Logan was its projector and his was the only name that seems to have been mentioned in connection with its directorship. By chance or purpose Logan, with his pet turtle in his pocket, was at the Astor House in New York when Lyell arrived, and Lyell was pleased to receive him when he called to pay his respects, but no reference is made to this intimation of Lyell's in Harrington's "Life of Sir William Logan," nor in any of Mr. Lyell's own books.

to send him on some notes of the Boston lectures as he wishes to use them for two lectures he was about to give at the New York Mercantile Library. The letter is stamped in red wax with a seal bearing the legend *Audacem favet fortuna!*

After the Lowell Institute, Lyell was free to lecture elsewhere and did so; and there were lectures scheduled for Philadelphia and New York, but not until he had spent the winter in excursions through the south as far as South Carolina. Coming back north in March for these engagements, he returns to Boston by way of the city of Hudson in order to cross over into the Taconic mountains, the seat of much geological and spiritual disturbance, for here lay the extensive sections which Doctor Emmons regarded as exposing his Taconic System, the lowest term in the life-bearing series of rocks. The opposing contentions assumed by Professors Hitchcock and Henry D. Rogers were that the entire Taconic series here was composed of altered or metamorphosed sediments of no earlier age than the low term in the New York series, the Potsdam sandstone. Hall and the other New York men had taken no active part in contesting Emmons's claims, doubtless being governed by a feeling of delicacy and a conviction that they must make no outward show of disagreement. They had wanted Lyell to see the Taconic rocks and draw his own conclusions therefrom, and after examin-

ing these western Massachusetts sections, he expressed the opinion that the "claim of this Taconic Group" "seems very questionable." It was an impersonal judgment based upon one of Emmons's secondary or accessory sections; the typical sections in Washington County, N. Y., he had not yet seen.

Lyell's lectures were causing Hall the greatest concern. The visitor had borrowed Hall's great "Geological Map of New York and the Middle States," prepared with vast pains and showing the latest stage of geological knowledge, and he had publicly exhibited it two years before it was printed, though with Hall's consent, how reluctantly given we can guess. He had chosen as the subject of one of his lectures, "The Recession of Niagara Falls," and had got all that Hall knew on that subject both by way of maps and of geology. Indeed, in his good will Mr. Hall really divested himself. It is not to be denied that it showed quick grasp and a cool spirit for Lyell, under such circumstances, to plunge into a public lecture on Niagara Falls before a great New York audience assembled in the "Tabernacle." And we may imagine the mixed thrills with which Hall read the account of this lecture in the *New York Tribune* as reported by no less a personage than Henry J. Raymond, then the assistant editor.

The lectures over, everybody went on to Boston for the meeting of the Association of American Geologists in April (1843); a splendid array of men gathered especially because of the presence of Lyell. The word had passed that Lyell was about to assimilate his American observations, derived now from many quarters, into a new edition of his "Elements," which would thus at once become an American text-book of the science. We may well believe that more than one American geologist had become nervous over Lyell's omnivorous annotations and the themes of his public lectures, for he was now possessed of their data, published and unpublished. Over this whole matter Hall had long been perturbed and out of this feeling arose an incident so absolutely characteristic of him; his warm and innocent receptiveness, hospitable largesse with his store of knowledge, followed by quick suspicions alarmed usually by irresponsible rumors; then too often the action, the regret, the remorse — that it is worth the telling not only because it has an historical interest but also because the end was all well.

When Hall came down to the Lowell lectures he spent six weeks in Boston studying Lyell's European fossils and making comparisons with his own. His many Boston friends, it would seem, expressed some wonder that he should have entrusted so much of his unpublished materials to

a stranger whose very acquisitiveness they thought should put one on guard. Greatly upset at the thought that his unpublished reports were in danger of being rifled, Hall hunted up George B. Emerson, whose influence in Boston scientific circles was then commanding, talked over the situation with him, and asked him to see Mr. Lowell and the other sponsors for Mr. Lyell. Then, when he got back to Albany, he wrote a protest against Lyell's "intrusion" into American geology, sent it to Emerson, who fixed it up for him and had it printed in the Boston *Mercantile Journal*. It was hastily done, made a great commotion in Boston, though beyond any question it was approved by many of the geologists who were much in the same strait as Hall.

The Boston waters were troubled for a whole season. Mr. Lyell went off south, but the printed article had gone abroad, and Hall was hearing from many of the geologists rather approving words, from Professor Silliman, particularly. Impulsively and perhaps unwisely, Hall wrote to Mr. John Lowell something of Silliman's views, and in April, just before the geologists meeting, he gets an intimation from his confidential friend and adviser, Augustus A. Gould, that he has stirred things up. Gould writes:

"Mr. S. of the City of Elms left us today and it seems that Lowell communicated to him the substance of the letter

you wrote. Young Ben is all in a foam about it today and thinks you succeeded in getting a coolness between Father and Mr. L. I should not be surprised if you should get your nose pulled again; so look out. What induced Mr. Lowell to raise the dust again I cannot tell."

There was a veritable tempest in the Boston teapot, and it boiled away for weeks until Gould wrote demanding to know just what Professor Silliman had written to Hall about Lyell.

"The most important thing of all," he says (Boston, July 20, 1842), "is that you should comply with my request and send me the extract from Silliman's letter — to give me as much of the context as will prove to measure the force of his expressions exactly. The rumor of this letter has got to the ears of Prof. Ticknor, Mr. Lyell, and Mr. Lowell, with the addition that I had seen the letter, and I fortunately escaped having Mr. Lowell make use of it in an inconvenient way. It happens that Prof. S. has taxed Mr. Lowell's endurance a little too much. This however must not go from you. Mr. Lyell too, has his eyes opened. He spent two mornings with me and went over the whole ground of your difficulty and some other difficulties. I will not recount, but suffice it to say that he now considers you the *dupe* rather than the *knave*. I repeat it, I must know the gist of the letter in question or the burden which belongs on other shoulders may chance to be transferred to mine."

Yrs truly & in haste

A. A. GOULD.

This was not the first demand Gould had made for Silliman's letter, but Hall had resisted till now. Meanwhile he had made various inquiries regard-

ing Lyell's intentions of publication; he wrote to Dr. John Torrey that Lyell had promised to wait until the New York reports were out, but he hears that Wiley & Putnam are publishing for him; to which Torrey answers that the publication matter was not yet "clearly determined;" that "Lyell was much hurt by the articles in the Boston papers accusing him of injustice to Mr. Hall," and says of him, "He [Lyell] was by no means popular in New York. Our men, of course, were offended by his reserved, cold manner and his indifference to the marked attentions that were offered to him. His lectures (except the illustrations) did not give satisfaction." Here is Hall's reply to Gould's request:

ALBANY, *July 22, 1842.*

MY DEAR SIR:

In regard to a letter of Prof. Silliman, I will comply with your request though I never intended to do so till now and the only reason that I do is to prevent your suffering in any degree. For myself I would not now say one word nor do a thing to bring the whole before Lyell as it is and was. He will know the truth some time or other. If I live over this I shall not sink under small things, and if I sink now I am worth but little.

The letter in question perhaps does not express as much as you understood from me. His conversation with me previously, 4th & 5th March was pointed & strong — and if you would learn his opinions at that time perhaps Dr. Cotting may be able to enlighten you, as he heard something of it afterwards.

I spoke to you of this letter of Prof. S. as expressing opinions at variance with those he expressed to Mr. Lyell, viz, that there would not be the slightest impropriety in publishing, &c. I give it you however as it is. I had informed Silliman in letter that we had heard that Lyell intended publishing, &c. After recommending a communication with Mr. L. on the subject & saying he is too busy to answer my letter fully he says: "I have confided this matter to Mr. Lowell & he thinks that it can not be so. You owe it to yourself and to all American geologists and to Mr. Lyell to have the matter put at rest, otherwise he will be placed in Coventry and will be an unwelcome guest on the 25th of April here. By all means see him without delay and let me hear from you."

Perhaps this expresses nothing at all, but taken with his conversation with me it seemed to me at least that he did not think it quite proper for Lyell to publish, as that was the only subject alluded to in my letter. His conversation of which I have memoranda was of a very decided character, and to this effect, that he thought on the whole I had done wrong to give Lyell so much information of the geology of New York as he might make improper use of it, and he would find it hard to resist the temptation to do so. He advised me in sending him specimens as I had promised to annex this condition, that Mr. Lyell was not to publish them till described by Conrad.

I did not anticipate anything of this kind and so far as myself was concerned, considered Mr. Silliman's letters and conversation as sacred after I had time to reflect upon it. While in Boston I was not in a reflecting mood, and indeed after my return for weeks, as B. S. Jr. suggested, that *I was on the down hill road and should get a kick from every one*. It has been to me a severe lesson but it has learned me much and I trust I shall profit by it. I wrote Torrey about that

time for his source of information but he only answered my letter a few days since. Lyell has acted so much more manly toward me than some others who were condemning him so severely that he must ever have my highest regard and esteem. I must acknowledge that I was proud of his friendship and anxious to retain it, but when from every quarter my course was condemned as giving to a foreigner the results of my labors and others to the prejudice of American science and those pursuing it, personal considerations were forgotten, and I was induced to act as I did, and as I then thought from proper and patriotic motives. But I have been judged and condemned and in my sentence others may see the fate of all Knight-errants in modern times.

Already remorse is gnawing furiously throughout his entire justification, for justification it was and as a justification the statement was received in Boston. Indeed, it seems pretty clear that this was no false alarm that had made Hall the spokesman for his fellows, and that he had really done a service equal to the measure of his dejection. Gould writes to him soon again: "Keep a stiff upper lip, going straight ahead, showing no resentment or subserviency. Mind your own business and, as I have always told you, there will be a recoil and you will come out bright. When we see Mr. Lyell here again *nous verrons*."

Of all this matter there is not a word in Lyell's letters to Hall. He does not, indeed, visit Albany again on this tour, but he writes frequently, even

after he had reached England, and on his return in 1845, bringing his "Travels in North America" with him, his first letter is to Hall, and his first inquiry of the Boston men whether Hall is satisfied with the notice he received in this book. Terms of intimacy in Albany are re-established between them, and presently Mrs. Hall inscribes her volume of "Poems" to Lady Lyell.

There is many a touch of the humorous in the impulses back of Hall's desires. This contact with Lyell and the apprehension over the suggested text-book of American Geology seemed to impress Hall with the conviction that he was himself divinely appointed to that very work. He writes to his friend George B. Emerson that he had long cherished the purpose to prepare a text-book of Geology for American Schools by an American; and could Emerson get it into the Massachusetts schools? Emerson tells Hall he doubts his ability to produce a successful book for students and advises him to stick to his fossils. Augustus Gould approved the idea —

"Don't be behind in that," he writes (September 30, 1842). "There are Wiley ones who will circumvent you if possible, and Harpies who will pounce upon everything unawares. You can do a thing which will displace everything elementary in the country, aye, in the world, and make your fortune to a certainty. Use all diligence else others with nimbler pens will gain the prize."

His friend Kendall, a member of a printing house, applauded loud and long. No letter from Kendall fails to urge the matter, and soon Hall has Gould, Kendall & Lincoln, Wiley & Putnam, and the Harpers, all bidding on this vague proposition. I can not find a scrap of writing which intimates that Hall had ever so much as drawn up a plan for his book, except about so-and-so many pages illustrated by pictures of New York scenery and fossils. He kept the project alive for years, and while he got no nearer to it, he would not let it get away from him. The exasperated Kendall berated him without ceasing for his procrastinations; but Hall had preempted the field and posted his *caveat*. Now let any one else enter at his peril. Just such procedure as this, grew to be, in his scientific work, a constant practise. In Palaeontology, where he was not lord by possession he was master by preemption — as his would-be competitors discovered.

The "Text-book" was never written. For ten years the plan slept in his pigeon holes, until Emmons stole in on his preserves, got possession of Hall's own woodcuts, and came out with his *Manual of Geology* (1850). From that time on Hall ceased to be interested in popular education in book form. We shall presently see that when the suggestion came, this interest revived in different expression.

Mr. Lyell, we have said, would not come back to Albany on this first visit, though Hall sent him an urgent invitation to do so. He circumscribed an amazing circle about it: "by Harpers Ferry, Forestburg, the Monongahela, Pittsburgh, Wheeling, Marietta, Pomeroy, Cincinnati, Big Bonelick, Lebanon, Columbus, Cleveland, Dunkirk, Fredonia, Buffalo, Niagara [without Hall this time!], Toronto, Kingston, Gananoque, Montreal, Quebec, Beauport, Three Rivers, Lake Champlain, Keeseville, Burlington, Green Mountains, Montpelier, Hanover, Concord, Nashua, Lowell, Boston;" and he had still a month before him for Halifax, Pictou and the Joggins. He had come into personal contact with nearly every active geologist in the country, he had given freely of his large experience and made friends everywhere in spite of their alarms, and he evidently carried away with him a high regard for his American colleagues.

CHAPTER VI

THE PALAEONTOLOGY OF NEW YORK

THE PERIOD OF VOLUME I—1843-1847

1

Beginnings — Legislation — Hall's arrangements with Emmons — Appointment as Palaeontologist — Proposal to Conrad and Gould — Changes in scope of work — Meeting of the Geologists in Albany, 1843 — In Washington, 1844 — Trouble with the National Institution — Hall seeks Secretaryship of the Smithsonian Institution — Visits Lake Superior — Lyell's second visit — Joins Hall and Emmons to visit Taconic Sections in New York — Hall's interests in horticulture; in collections; in *Castoroides* — Invited to Alabama University.

THE title of this chapter is the caption, the dominant note, of all the long remaining years of Professor Hall's life.

In any extraordinary undertaking, next in order of interest to its outcome, are its beginnings, the struggle that got it afoot and on its way. The Palaeontology of New York was an extraordinary undertaking; rarely had a work of its scope or magnitude ever been projected and its achievement ran far beyond the bounds of its author's vision or most audacious hopes. To-day its thirteen great quarto volumes, with innumerable accessory treatises, stand an unparalleled monument in the science,

and if ever surpassed in bulk, certainly not in orderliness, lucidity and completeness.

The inauguration and creation of such a stupendous work demanded a man of indomitable enthusiasm, intense convictions, fervent loyalty and a courage verging on temerity. Hall was that man and his beginnings of the work are therefore of inviting concern.

Hall had abandoned his cherished plan of going to California on a Government mission; Lyell had gone home and the final reports of the geologists were out. But the rocks of New York were crowded with still unchristened fossils; Hall's Fourth District was carpeted with them; his western tour of four thousand miles was through gardens of them lying about him nameless, like the plants of Hingham. Conrad had thrown up his hands in dismay as the four geologists turned in upon him their accumulations of fossils for his determinations. Thus the survey was over but the fossils were mostly untouched, and there was besides, a vast collection of geological material which had been sent in by the members of the staff and stored away in the geological rooms at the corner of Hudson and South Market streets. Mather had gone back to Ohio, Vanuxem had retired to his home in Bristol, Pa., Hall and Emmons remained in Albany and both wanted to continue the work in Palaeontology. The need of this

supplementary work was recognized by the friends of the Survey and the fresh series of sumptuous volumes made the introduction and passage of the necessary legislative provision an easy matter. It was a bill authorizing Governor Bouck to appoint the proper men to take charge of the Palaeontology and of the collections and collection rooms, the nucleus of the State Museum. Hall writes to Gould (March, 1843):

"The bill will be passed before you get this. * * * Dr. Emmons has been endeavoring to obtain the last office [custodianship] for more than a year and has the recommendations of all concerned in the Survey to that effect. I have given up this to him more than six months since, though he had previously promised me his influence to obtain it. But this is only incidental. Now that there is an opportunity of going on with this work on fossils *I want to have it* in my charge and if necessary wish to be fortified."

Then he asks for the endorsement of the Boston men, Gould, Emerson, Doctor Cotting¹ and Jackson; Rogers had already promised his approval. "I have been close at work" says Hall, "for the last year almost entirely at these things and have now between 300 and 400 species figured." Perhaps nothing could show more clearly his definite intention to have this work than this last statement.

¹ Dr. John R. Cotting was one of the older members of the Boston scientific circle. He had very practical experience in geology, having undertaken to carry on an agricultural and geological survey of Georgia in 1836.

Forty-nine years afterward Hall himself told the story of the denouement in these words:

"Emmons was here drawing pay as geologist and agriculturist as well as Professor of Chemistry in the Medical College. From some cause there was a growing disaffection toward him in the college at about the time our geological reports were completed. T. Romeyn Beck who was running that institution, running everything then, got him transferred from that position to the chair of Obstetrics greatly against Emmons's wish, who felt the position to be not so honorable a one, but Beck wanted the chair of Chemistry for his brother Lewis C., and though Emmons had friends in Dr. March and Dr. Armsby, they could not nullify Beck's wishes. This seemed to be the beginning of his disquietude. After our reports were in and printing he said to me: 'Now here's a good place for you in charge of the museum in the State Hall,' which was being prepared for their reception,² 'and I'll do what I can to help you do it.' He had a good salary besides his agricultural work and I had nothing. He had many influential friends and I had but few. It very shortly turned out that Emmons had been to Governor Bouck with his friends on his own behalf, and that on their representation the Governor had expressed the intention of putting the museum in charge of Emmons, he agreeing to prepare and have in readiness a report on the palaeontology and agriculture within one year. When I heard of this I went to Emmons and he said to me. 'I'll look out for

²The "State Hall" of that time, also known as the "Old Capitol" was made over, in 1855-6, into the "Geological and Agricultural Hall," at the corner of State and Lodge streets. The "State Hall" of after years, from 1886 to 1912 the office of the State Geologist, is now the Court of Appeals Building at the corner of Eagle and Pine streets.

you; you'll be all right.' 'But' said I, 'I won't take anything of that sort and we'll have this matter settled immediately.'

I remember that this all happened the day before the meeting in Albany of the American Association of Geologists and Naturalists, which was to be held in the State Hall. It was in April, 1843. That night I walked the streets of Albany. I did not go to bed but sat up trying to think of some way to save myself. Early in the morning as I was at work in the museum in came George B. Emerson of Boston, President of the Boston Society, who had come to attend the meeting. 'Hall, what's the matter?' said he. 'You are not looking well.' It did not need much encouragement for me to tell him the whole story, and when I had finished, he said 'Well, I don't know as I can do much to help you. Dr. Emmons's relations to me are not pleasant and I can not see him.' He then went on to tell me how he, as one of the Commissioners of the Natural History Survey of Massachusetts, had engaged Emmons to prepare a report and that when Emmons had sent in his manuscript Emerson had found good reason to return it and that he had held no intercourse with him since. While he was talking, in came Professor Potter of Schenectady, afterward Bishop Potter of Philadelphia, and to him the story was told. Pretty soon they two started up to the Secretary of State, Sam Young's office. Then I saw the three walking up Washington avenue to Governor Bouck's house, then owned by General John A. Dix [Dr. Elting's house]. It was not long after that I received my commission from Governor Bouck to prepare the Palæontology."

This is the story as he told it, but still it lacks something of essential detail. Governor Bouck was from "Old Schoharie," a stronghold of the

Whig-Democrats ever since its emergence from the sea. John Gebhard, Junior, was of the Schoharie fold and he not only wanted the curatorship but he had earned the right to go to his neighbor, the Governor, and ask for it. He did so and got the promise of it. So much at least was secure before any of the appointments were made and meanwhile Hall begged Gebhard to see the Governor on his behalf — which he did evidently to some effect. And so Gebhard was made Curator; Emmons, Agriculturist and Hall, Palaeontologist. Agriculture had not been included in the plan of the original Survey and thus Doctor Emmons had a broad field and a free hand. It is not difficult to conceive the sensations with which Hall saw Emmons assigned to a pasture so remote from his own, nor perhaps his later sensations when Emmons's first volume on the Agriculture appeared with its opening chapter given up to a lengthy account of the cloud-capped "Taconic System."

Hall had now come into his own; he was thirty-two years old and had all his heart's desire. He is delighted; his friends are delighted. Henry D. Rogers sends word that there could not be a better appointment; that he had already shown himself the most expert American Palaeontologist. The versatile Haldeman writes: "I feel very confident that you will be more likely to do the subject justice than any other person connected with your Sur-

vey." Lyell sends word from No. 16 Hartley street of his "unmixed satisfaction;" Emerson warns him "to stick to his agreement with Emmons;" and the sprightly and effervescent Gould cries out: "Hurrah for Palaeontology! What a glorious chance you have if you can ever accomplish your work without quarreling! Benjamin Silliman, in sending his good wishes, speaks of Hall's Fourth District report as a "great national work," and this expression may be taken as a veritable intimation of the esteem in which Hall was now held by his colleagues. His high standing was established and more than that, he stood forth as the representative of a State that was priding itself on its patronage of science. Alcide D'Orbigny, the leader of the French geologists, had written to him:

"I need not express to you, sir, the pleasure I have experienced in receiving your important publication on the State of New York. You do in America much better than is done in Europe. Your governors comprehend their interests and the honor of the nation and you give us a lesson which we should learn if politics did not absorb all our statesmen. The important publications which you make at the expense of the nation, are here supported by private individuals, which augments the difficulties to be surmounted and requires more union among those who are occupied with the same subject."

Mr. Hall had now entered into an undertaking to prepare a report in one volume on the fossils

of the New York Formations and to have it done in one year. I think to get the work afoot he would have assented to almost any promise that did not wholly eliminate his refugium, his *Deo volente*, which was a religious reservation on all his agreements for a half century. Forthwith he reaches out for assistance. He sends Conrad an invitation to join him in one phase of his work, the bivalved Mollusca, and when Conrad declines he writes Gould to take over all the Mollusca. Doctor Gould was highly expert in recent conchology but he stood in some dread of imperfectly preserved fossils and though the proposal tempted him, Hall hardly waited for him to decline before he was into them himself. At once he began the collection of new materials from every part of the State and from all its formations, and by the end of the year he had swamped himself; he was buried under the organic remains of all the palaeozoic seas and his report "in one volume in one year" was buried with him. Meanwhile Silas Wright had become governor and as the promise to Governor Bouck could not be, in the eye of science, fully met, Hall divested himself of his unredeemable concessions and proceeded to give his attention wholly to the fossil faunas of the "Lower Strata."

This, then, was the theme of Palaeontology I, and with it he proceeded with entire deliberation, feeling his way at every step of this virgin adven-

ture. He sought and acquired material from every quarter, mostly at his own expense; he established his species with keen circumspection and he sought the best efforts in depicting his fossils both in drawing and lithograph. And in all of these he succeeded, for he described from these "Lower Strata"—the Potsdam Sandstone, Calciferous and Chazy limestones, the Trenton series (Birdseye, Black River, Trenton limestones), the Utica and "Hudson River" shales—381 species where but 70 had been before known; his plates of lithographed illustrations, 90 in number and drawn by Mrs. Hall, called forth much praise from his critics and his work entire embraced what are still recognized as the body of the typical or guide fossils of the formations to which they belong. In the face of his altered plans he went to the legislature of 1845 and told them he had spent all his money and needed more, and they gave it. In 1847 the book was done and printed and instead of *The Palaeontology of New York* in one volume in one year he gave to Governor Wright, after four years, the first of thirteen quarto volumes with many hundreds of plates and thousands of pages.

As far back as 1842, before even this work had been provided for, or the field had been divided between himself and his older competitor Emmons, Hall had it all planned. "I know it will be the work of a life time," he wrote to Gould, "and I

propose to cover the fossils of all the rocks below the Coal over the whole United States." As the later years often showed, Hall's determination was irresistible and it is doubtless true that in the division of the new functions he outwitted Doctor Emmons.

In the further consideration of Professor Hall's career it seems well to divide it into epochs each characterized by the execution of a volume of the *Palaeontology of New York*; for whatever other things he was concerned with, these marked off the hours upon the dial face of his life. Other events may be given their due weight within this classification. So now having noted the completion of volume 1, in 1847, we may go back to take up some of the lively sidelights of the years of its incubation.

In 1843 the new Association of Geologists and Naturalists (organized the year before in Boston), met in the old Geological Hall at Albany with Henry D. Rogers presiding. It was a day of triumph for Hall, for his fresh assignment gave him great prominence and he was already the leading figure among the younger American geologists. The gathering was notable in its personnel. There were the two Sillimans and Dana (father and son and son-in-law); Dale Owen, Douglas Houghton and Nicollet from the West and South; Charles T. Jackson and George B. Emerson of Boston, Bailey

of West Point, Redfield of New York, Morton and Haldeman of Philadelphia, the distinguished Hitchcock of Amherst and, as host, the ubiquitous and urbane T. Romeyn Beck. Though it was the first appearance of the "Naturalists" in this Association, the naturalists were practically all geologists; and Owen remarks in a letter after the meeting upon the evidence that geology is "the science of the day."

If there was one dominant theme in these meetings it was the problems of the palaeozoic rocks. Rogers, Owen and the New York men were full of them; Houghton was seeking Hall's help in solving their relations on the Lake Superior shores; Dana, not long back from the Wilkes Exploring Expedition¹ was pregnant with ideas on corals and coral islands which, he says to Hall, "I shall be glad to take this opportunity to make public." He had "something to say on the regions of elevation and subsidence in the Pacific, in which I disagree entirely from Darwin, although I adopt his general theory with regard to the formation of coral islands." We find Dana soon diligently comparing notes on these things with Hall and even describing the fossil coral genera of New York.³

¹ Intimate relations between Dana and Hall had been of long standing and had a curious beginning. In 1837 Hall had written a paper on some Utica shale trilobites (*Triarthrus*) among which he thought he had found a new species. He sent his manuscript on to Dana for *Silliman's Journal* and the latter, having been

In the spring of 1844 the Association met in Washington, and Benjamin Silliman, Jr., writes to Hall on April 23:

"I write now chiefly to say a word about the approaching meeting of the Association. You of course will be there and as usual full of papers and interesting facts. We have great need of all the force we can muster at Washington, to stem the influence which the National Institute have indirectly excited against us in forstalling the public mind by their late meeting and more than that, by the ambiguous wording of their circular in having led some of our members to believe that *their* meeting was identical with ours, and

raised among the fossils of this shale at Utica, N. Y., had specimens from home which did not altogether support Hall's conclusions. Hall had gone off out of reach to the mining regions of North Carolina and so Dana with genuine friendliness entirely rewrote Hall's paper with what he believed were the necessary changes, and printed it in the Journal. Hall never demurred, but the paper made a little tempest among other palaeontologists and after the organization of the Geologists Association, Haldeman was made chairman of a committee to pass upon the momentous question raised by this issue, now become complicated with certain similar issues emanating from the "Taconic System." Writing to Hall in 1846, nine years after the fact, Dana says of this "Trilobite affair"; "I have had more regrets than for anything I ever did in science. * * * I ought to have let the manuscript alone. * * * No apologies I can make will relieve me of regret and I leave the subject. 'Live and learn,' says the old proverb."

It is interesting to note that Hall wanted to go on the Wilkes Expedition, a natural ambition for a young man looking for opportunity to enlarge his experience. He tells Dana that his knowledge of botany, geology and natural history generally ought to make him of service. Professor Dana went out as "Mineralogist" and returned to make a distinguished reputation as "Zoologist" of the Expedition. Hall was one of many ambitious candidates who were lost in the repeated shuffling of this scientific corps.

we had "*kindly consented*" to an united meeting; e. g. Locke and Mather both came on with that impression. I have issued to all the members a newspaper with a revised notice intending to correct this impression as far as possible and you have probably received it ere this. H. D. Rogers has written me that he shall be at W. with a short address — and a good number of members have written their intention of being there.

We shall have no band of music to fill up our intervals with bass drum and bugle, as at the meetings of the Institute, but we must have interesting discussions of which they had none, and we must show them the difference between deep and shallow water.

This sharp reference to the "National Institution" calls to mind the memory of a learned organization which was conceived by representative spirits in Washington and established in 1840 "to promote science and useful arts." Doctor G. Brown Goode and Dr. Richard Rathbun have, among others, left interesting accounts of the association whose membership included Cabinet officers, members of Congress and leading citizens from the entire country. The dominant personality in the Institution was Joel R. Poinsett, of South Carolina, Secretary of War. In 1844, under Mr. Poinsett's presidency, the Institution was reaching out for congressional support in the attainment of its aims, which seem largely to have been the establishment of a National Museum and the control of the Smithson bequest. Doctor

Goode (quoted by Dr. Rathbun) says that in April 1844 a "meeting of the friends of science, including, besides all the members and patrons of the National Institution, the members of the American Philosophical Society and of the Association of American Geologists and Naturalists, had been held in Washington. * * * It was a gala week for the National Institution. The meeting was in every respect a success and there was every reason to believe that Congress would share in the general enthusiasm and take the Society under its patronage." But Congress did not; "the hopes of the promoters were doomed to disappointment" (Rathbun); Poinsett resigned the presidency, the Society made one more effort to meet and then expired. The intimations in Silliman's letter to Hall, although veiled in perfect knowledge, seem to imply that the geologists must have obstructed the plans and hopes of the Institution; at all events the geologists survived and the Institution died forthwith, and to its little assets the new Smithsonian, just organizing in 1846, fell heir.

Tremendous interest centered about the disposition of the James Smithson bequest which had now lain at interest for its twenty years, and there were plenty of aspiring candidates for the executive secretaryship for which Congress was providing in the "Establishment" — men who doubtless felt that no comprehending body of "Regents"

could pass them by. There was the Honorable Caleb Cushing of Massachusetts, just returned as Special Commissioner to China, and Francis Markoe, a secretary of the Philadelphia Academy and a successful collector of scientific objects, Professor James S. Greene of Princeton and Henry D. Rogers. Professor Hall himself was not devoid of ambition in this direction and his recognized standing among the leaders in a very popular science was a justification so far as eminence and promise in his profession were concerned. So he asked the younger Silliman to make inquiries in his behalf at Washington and Jeffries Wyman who was then at Richmond, Va., also looked into the matter for him. He interested his friends, Major Williams of the Patent Office and Thomas T. Everett to keep him informed of the progress of affairs; he even got Lyell to write to Professor Henry regarding his chances. But as soon as Professor Henry was elected to the secretaryship no further reference to the matter seems to have been made by Hall, and it is evident that the project did not lie heavily upon him.

His salary was modest, he had to avail himself of outside opportunities and this brought him into connection with the Lake Superior Copper Company, a private enterprise but an outgrowth of Dr. Houghton's explorations in the Michigan Territory. This company had enlisted the attention of

several of the geologists and Hall was employed by them in 1845 to examine their holdings. This was before the organization of the government survey of the mineral lands under the General Land Office in charge of Charles T. Jackson, but Dr. Jackson had already been on the ground with Professor Charles U. Shepard, the eminent mineralogist of Amherst and Yale. Thus he made his first entry into a region to which he was to give much subsequent study in connection with the Foster & Whitney explorations, but this time he was on private business and there joined James T. Hodge, a geologist who had been assistant to Rogers on the Pennsylvania Survey. There has been no printed account of this trip, but I here insert for its historical worth, Hall's story of it as written out by him for Dr. Alfred C. Lane (1896) then assistant to Lucius L. Hubbard, the state geologist of Michigan.

"The chief object in my going to Lake Superior was to make an exploration of Isle Royale, as it was at that time a question in Washington whether that island should not be reserved from the public privilege of making mining locations, since it was believed to be remarkably rich in ores of copper and silver. A surveyor, Mr. Hodge of Niagara county, was designated to conduct the surveys under my direction. We organized a party numbering altogether eight men, two of whom were French voyageurs whom I engaged at Detroit. I had purchased provisions and some other things for our outfit in Cleveland. At Detroit I

bought a two-masted sail boat which had been built expressly for sailing in that neighborhood, adding to our outfit other things that were necessary. We thence proceeded to Mackinaw by steamer and there purchasing a large Mackinaw boat we transported all our provisions and other necessary articles of outfit to the Sault St. Marie, expecting to go on board a schooner for Copper Harbor. Finding this schooner (the *Swallow*) still on the ways between the Sault and the lake above, with a certainty of being delayed for at least a week on this account, I left everything in charge of Mr. Hodge and his associates.

"At Detroit we had been joined by Mr. James Wadsworth of Geneseo N. Y., Hon. Francis C. Gray of Boston, and Mr. Olmstead, a son of Prof. Olmstead of New Haven, who were on their way to Lake Superior for the object of general exploration. An Indian agent with his wife, a halfbreed, living at the head of Lake Superior, had joined us at Mackinaw, and we were all anxious to get forward without waiting for the launching of the schooner into Lake Superior. In this predicament we purchased at the Sault two large birch canoes, each one twenty-five feet in length. Manning these canoes and taking a small amount of provisions we started on our coasting trip to Copper Harbor, keeping well in shore during the day and camping on the beach at night. The trip was a very pleasant one in all respects except its slowness. Arriving at Copper Harbor we waited the arrival of the schooner *Swallow*, which came along some days later bringing our provisions, tents and men, except the two French voyageurs who had come in the canoes. From Copper Harbor we were taken to Isle Royale on the schooner *Chippewa*, carrying with us only our provisions, tents and other necessary articles, and our sail boat which I had purchased at Detroit, and one birch bark canoe of twenty-five feet in length. We were landed

in a little land-locked harbor which we named Chippewa Harbor, after the schooner which brought us over. At that point we made our rendezvous, and began exploring the island, taking with us the small sail boat and the canoe, coasting along the south shore to the eastward, and penetrating the interior on foot at intervals, as far as practicable. We also visited and explored the little island to the eastward of Isle Royale.

"At one place on the north side of the island we discovered copper and silver both in pebbles and in the rock, and marked this location upon our map, it being the only one observed which seemed worthy of serious consideration. At this place there was a small sheltered cove or inlet of very little consequence, but which we designated on our map, but the name I have now forgotten, and it has long since, I dare say, become entirely changed or obliterated by the explorers' work. This place subsequently became important from the discovery of an old working and a large mass of native copper, as I have been informed. Following the northern coast of the island to the westward, and turning south, we came into Washington Harbor, where we remained for some time exploring the country as far as we could, though we were not prepared to cut paths and make our way as would have been desirable for a thorough exploration of the country.

"From Washington Harbor we went along the south coast to Chippewa Harbor, our permanent rendezvous, and waited there for the anticipated arrival of the *Chippewa*, whose captain had made an appointment to meet us at a certain date. We waited two days beyond this date and our provisions having been nearly exhausted and the party becoming dissatisfied, I yielded to their importunities and agreed to attempt to sail across the lake to the south shore. The day proved a very boisterous one; a strong west wind

coming up after a southeaster made it extremely dangerous. Notwithstanding we were nearly swamped several times we arrived at Copper Harbor on the south shore late at night, bringing with us the collection of specimens that had been made upon the island. We afterwards explored the south shore of Lake Superior, stopping at the localities which were then worked at Eagle River, Eagle Harbor, and other places as far as the Ontonagon River.

"I made a report to the parties who sent me to the island, but this report was never published. The desired information having been obtained I think the authorities at Washington opened the island soon afterwards to the public for making mining locations."

Hall stayed late in the season and Hodge went back to Boston whence he writes to Hall at the "Lake Superior Mines" in November a gossiping letter which is interesting now for its frank references to Jackson whose explosive eccentricities were forever getting the accomplished Doctor in trouble; to Henry D. Rogers, then an active candidate for the Rumford professorship in chemistry at Cambridge (which was to go to Horsford); to Charles B. Adams, State Geologist of Vermont and to Sir Charles Lyell; and in one of the last of these there is a pathetic touch where he refers to the drowning of Douglas Houghton (1845): "Truly it is a most serious loss to the State of Michigan, the United States and to the scientific world." Twenty-six years after, Hodge was him-

self drowned in Lake Huron while on his geological work.

Sir Charles Lyell had come back, in 1845, for his second tour among the States and brought the published story of his first visit, his "Travels in North America," with him. The book was so attractively written, so filled with lively appreciation and generous expression toward the American institutions inclusive of the geologists, that it made an agreeable passport, if any were needed, after the slight eruption at his previous visit. It was the Lowell Institute lectures again that brought him but as Lyell was not an attractive lecturer, the acclaim of his advent had died down and he devoted his time to more travel among the geologists and their fields, though he did not come to Albany until the close of his journeyings, in May, 1846. This visit was made at the joint solicitation of Emmons and Hall, both of whom wanted Lyell to see the typical New York section of the Taconic System at Bald Mountain in Washington County. So the three, after one more trip over the Helderbergs (still aflame with the "Anti-Rent War") and across the Hudson to the interesting "Silurian" (Ordovician) exposures on Rysedorph hill in Greenbush, went north to the Battenkill and the Bald Mountain overthrust. Here Emmons had found the trilobites on the basis of which, in part, he threw the entire rock series containing them,

and much more besides, into a system — the Taconic — lower than the Potsdam sandstone, that is, lower than the lowest term of the rock succession admitted by his New York associates. The trilobites were there. Time has shown that Emons was right as to their age and position and they were the first “primordial” fossils found in America. Lyell saw the fossils but did not comprehend them; he had left behind in England a similar problem hotly debated by Sir Roderick Murchison and Professor Sedgwick of Cambridge and as a disciple of the former he construed the Silurian in its broadest sense. “I believe” he writes after this visit, “the formation called Taconic in the United States to have claim to no higher antiquity [than Silurian] and to be simply Silurian strata much altered and often quite metamorphic.”

In the intervals of these doings Hall bubbled with enthusiasm over the garden he was planting at his new home on Lydius Street [Madison avenue]. He loved plants and fossils and the plants had been first in his affection; so Joseph Clark of Cincinnati promises to enclose with the fossils he is sending, a few strawberry plants, the “Iowa,” the “Mammoth” and the “Kean Seedling;” and these are followed by cuttings of the “Catawba,” “Missouri” and “Isabella” grapes, with a few slips of Osage orange. Doctor Sart-

well, the botanist of Penn Yan, sends him cuttings of the "Wayne" apple, and so on. There were boys to help through college, and boys who sought and found in him every encouragement for their collections in natural history.

"Sir," wrote young J. F. Wilkinson from Syracuse, "do you recollect that when Mr. Root,⁴ the teacher of the Academy here was in Albany and went to the room where your Cabinet was, there was a boy with him? I am that boy. You promised to send him a box of minerals.* * * Mr. Hall: P. S. You need not label them unless you choose to."

Soon Louis Agassiz arrived and was charming everyone with his lectures; forthwith Hall would lecture, and tries to get Dr. Samuel G. Morton to arrange a course for him at the Philosophical Society at Philadelphia. To the end of his life Professor Hall failed to realize how dull a lecturer he had become. Through Benjamin Hale, President of Geneva (Hobart) College, he had got hold of a recently discovered skull of the giant beaver from

⁴This was Professor Oren Root, father of the Honorable Elihu Root. As a schoolmaster in Syracuse, Utica and Seneca Falls he was an intensely enthusiastic student and collector of minerals and in constant communication with Hall. Just before leaving Seneca Falls to take the professorship of natural history and chemistry at Hamilton College, he was very desirous to sell his collection, but failing, he took it to Hamilton where it formed the nucleus of the scientific collections of the College. The Memorial of Professor Root's beautiful character and fine educational service appears in the Proceedings of the Twenty-third Convocation of the University of the State of New York, 1886, p. 220.

the swamps of Clyde, N. Y., and at the urgent recommendation of Dr. Gould, had turned it over to Dr. Jeffries Wyman for description. Together they published a monograph of this great *Castoroides* skull, but it took endless correspondence between President Hale and Hall to put the unique specimen back into the halls of Geneva College.⁵

Just at this time Hall was invited to the professorship of Mining Geology and Agricultural Chemistry in the University of Alabama, but a salary of \$1700 a year did not prove very tempting, though accompanied by a half promise that he should be State Geologist if he could succeed in arousing a proper sentiment for a survey.

⁵ It is now in the State Museum at Albany.

2

Arrival of De Verneuil—His appreciation of Hall—
 Their trips together—His influence on Hall—
 Murchison and Sedgwick; the Silurian and the Cambrian Systems—The Devonian System—Letter from Murchison—Its effect—Later letters from De Verneuil in the Revolution of 1848—Arrival of Louis Agassiz—His commanding influence—Enthusiasm of his reception—Immediate visit to Hall—Agassiz's impression of the New York Survey—Roemer's visit—Carr wishes to be State Geologist of Vermont—Charles T. Jackson—Hall's report for the Frémont Expedition—Geology in Mississippi

THE important events of the year 1846 were the arrivals in America of Louis Agassiz and Edouard de Verneuil; one from Switzerland, the other from France; one a great naturalist in the broad sense, the other a successful student of the ancient rocks who had attained distinction not alone from his work in France but also by his cooperation with Sir Roderick Murchison in studies of the palaeozoic formations of Russia and the Ural Mountains. Already Count de Verneuil's enthusiastic felicitations on the Fourth District Report had reached Hall with the assurance: "I can not read your work without experiencing a strong desire to visit a country so rich in palaeozoic fossils and where the succession is already so well

established that it outstrips the efforts we have made in Europe to decipher this obscure page in the history of the earth."

The geological reader must remember that until the work of Sir Roderick Murchison and Professor Adam Sedgwick in Britain and in the Eifel, of Murchison in Scandinavia, of Murchison, Count de Verneuil and Count de Keyserling in Russia and of the geologists in New York, nothing was known of the true order of the rocks below the "Coal." These undertakings were therefore all in a new field and had all the glamor of explorations into an unknown country. The coming of De Verneuil was a first visit to America from a pioneer in this European field. On his arrival in Boston he found Lyell, who advised him to spend all the time he could at Albany in studying Hall's collection, "as the richest and over all the most scientific in the States" (De Verneuil to Hall, May 22, 1846). He took Lyell's advice, spent several weeks among Hall's collections and in visits to the Helderbergs and Schoharie and then partly under Hall's guidance and partly with his pockets filled with Hall's letters of introduction, he made his visits to the best of the New York localities, into the Middle-west and thence to the Lake Superior district to which American attention was then being closely given. Thence he returned to New York to visit Moscow and the Portage falls of the Genesee river,

and his letters to Hall on this trip are full of critical and suggestive observations. De Verneuil's trip was cometary; he was back in Paris by the close of the summer; he made no notes on people and things but gave himself wholly to the purpose of studying the palaeozoic fossils, unfailingly urging upon Hall the importance of adopting Murchison's classification of the palaeozoic rocks and preventing Professor Sedgwick's term Cambrian, so offensive to the Murchison school, from invading the New World. Many things resulted from De Verneuil's visit, among others a very important comparison of the ancient rocks and fossils of America and Europe, published on his return to France, and with the author's consent translated, amplified and published by Hall at a later date in his report on the survey of Lake Superior and in the *American Journal of Science*. De Verneuil went back really much perturbed over Hall's evident purpose to recognize Sedgwick's "Cambrian" division as against Murchison's extension of his Silurian System downward to include these rocks. Let us look into this matter historically a moment; it involves one of the very important issues in the development of the science. Sir Roderick Impey Murchison had announced somewhat vaguely in 1835 his conception of the Silurian System and in 1839 developed and defined it. That his activities were accelerated by a knowledge that the New York geologists were at

work in the same field there is no doubt, nor is there any denying that it would have been better for American geology, if not for the science, if the definition and name of this system had been taken from the lucid New York sections with their clear lower and upper boundaries than from the greatly disturbed, abnormal and still undefined sections of North Wales on which these studies were based. More than that, the Silurian System comprehended terms that were as independent of each other as the whole was from the overlying Devonian. Contemporaneously, Professor Sedgwick of Cambridge, studying the rocks of North Wales, worked out a system which he called "Cambrian" and which, as it proved, included all the lower term of the "Silurian" and, besides, a series of basement beds which Murchison excluded from his system. Sir Roderick was a personage of great social and scientific distinction, and as he was soon to succeed De la Beche as Director-general of the Geological Survey of Great Britain and Ireland, his position was such as to exert a powerful influence against the invasion of his "Siluria," and he did drive out the invader so that the term Cambrian became eventually restricted to rocks represented in the lowest part of Sedgwick's original system. But this controversy over the interpretation of the geological column and the contentious personal claims

of Murchison and Sedgwick had a most unhappy outcome for the science. A threefold division in the "protozoic" rocks had become evident: Upper Silurian, Lower Silurian, Cambrian, as the Murchisonians would have it; Silurian, Upper Cambrian, Lower Cambrian, according to the Cambridge adherents of Sedgwick; Silurian, Cambro-Silurian, Cambrian of the "mutual friends." But as none of these could be assured of general acceptance, Lapworth in 1877, introduced for the offending middle term the ugly word Ordovician which has unhappily limped into use, though no American geologist ever writes the word without a protest and certainly a New York geologist having before his eyes the term "Champlain," applied to these formations in 1843, can not employ the word without conscious loss of self-respect. Be this as it may, the "Silurian System" was abroad before the New York men had suggested a grouping of the equivalent formations into three major terms; Ontario, Mohawk and Champlain.

Murchison and Sedgwick maintained harmonious cooperation in their geological studies until the early years of the 1840s. In 1839 jointly they defined the "Devonian System" from a study of the badly disturbed marine strata of Devonshire, a system lying between the Silurian and the Old

Red Sandstone. Regarding this announcement Professor Schuchert has written:⁶

"So fearing that the New York State Geologists would soon propose a period name for equivalent formations, they hastened their work and in the same year defined the period term Devonian. Their definition was no definition in the sense either of delimitation or zoological characterization; both rocks and contents were curtailed, deformed to a mere abstraction, and to develop their conception the authors betook themselves to the Rhine Valley whence a more perspicacious exemplification of the Devonian was educed. * * * If our English cousins had waited until 1842, the period would now be called Erian and the State of New York would have been the type area, than which there could have been no better."

When Sir Roderick learned from De Verneuil that Mr. Hall was likely to adopt for New York the name Cambrian in Sedgwick's meaning, he sent him the following letter, so important in showing the influences bearing on the classification of the rocks of the State, that we give it entire.

BELGRAVE SQUARE, London, 23 Dec. 1846

MY DEAR SIR—

On his return from the United States, my friend and coadjutor M. de Verneuil rejoiced me by explaining to how remarkable a degree the natural divisions of the palaeozoic rocks of N. America coincided with those we had been occupied together in applying to Europe. I also learnt from him, with much pleasure, that you were about to continue

⁶Textbook of Geology, p. 695.

your great work and to generalize the comparison of the N. American groups with our European divisions. At the same time I could not but deeply regret to learn that you had some intention of applying to the great protozoic division which is typified by fossils I published as Lower Silurian, the name of Cambrian. Presuming that you may not yet have quite decided upon your course in regard to this subject of nomenclature, permit me to state my views to you and explain the grounds on which I still hope you will adhere to the names now generally used in Europe and which must prevent the application of a term which has never yet been defined by any zoological characters.

In the year 1835 (June), after four years of previous labour "ad hoc," I proposed the term Silurian System and then divided it into an Upper and Lower group, each characterized by typical fossils. As soon as this name was approved by English and continental geologists, I urged my friend Professor Sedgwick to apply some distinct name to the large mass of slaty rocks which as a whole seemed to rise up from beneath my Silurian System.

The term was used in precisely the same sense as the word Silurian; *it being hoped* that the rocks so named would be found to contain a series of organic forms as distinct from those of Siluria as the latter were from those of any overlying deposit.

It was with this meaning that the word Cambrian was used in my Silurian System, finally published in 1839, and Professor Sedgwick undertook to develop the nature of his Cambrian fossils. Years rolled on and the palaeozoic relations above the Silurian were cleared up by the establishment of the Devonian System, but *nothing was done to typify the Cambrian*.

In this state of things the survey of Russia and Scandinavia commenced, and the result was (as you know) the

demonstration that the strata there loaded with Lower Silurian types reposed on crystalline rocks without fossils. At the same time Cambria being more explored, it was found, and even admitted by Professor Sedgwick himself that all its lower rocks contained nothing but Lower Silurian fossils. Hence I announced in my discussion of 1843 (Geol. Soc.) that the Lower Silurian extended downwards throughout the principality, and a general map of England was coloured on this principle, of which 8,000 copies were circulated by the Society for the Diffusion of Useful Knowledge. Lastly, in 1845 the work on Russia was published and before the first chapter (the last printed) was issued, I sent it to Professor Sedgwick who made no objection to the views contained therein. Thenceforward I naturally thought that the terminology applied to such large regions of Europe and adopted by French, German, Swedish and Russian geologists (as well as by those of Britain, including Sedgwick himself) would never more be interfered with. My surprise therefore has been great and my regret not less so, to find that Professor Sedgwick (unable to say that the so-called Cambrian Rocks are anything zoologically but Lower Silurian strata) after using my Upper and Lower types in working out the complicated relations of his country, should now go the length of proposing the *substitution* of the word Cambrian for Lower Silurian! Now on this point I have protested (and I believe every English geologist except my old friend will support me), in opposing this desecration of my System by cutting off from it *its lower half*, that half being much the most considerable as to the area it occupies.

All English palaeontologists are agreed that the Lower and Upper Silurian form *one natural system* and *not two*. In addition to the community of fossils (as genera) so many species have now been found to run, if not nearly through,

at all events so intimately to connect the two groups, that their isolation by distinct names is inadmissible. The British Government geologists' assurance is that this is peculiarly so in Cambria itself and hence that one name only can be used. It would surely, therefore, be a singular recompense for all my labours if the Silurian System should be so attenuated, so deprived of its larger part *as scarcely to be recognizable on general maps*.

Referring to general maps, it does not even now occupy one-half of the area of the Devonian System in Russia or Scandinavia and not a twentieth part of the area of that system in Germany. But if the Lower Silurian be abstracted, the *very name* would be driven from the mainlands of Russia and Sweden and confined to the Baltic Isles; whilst in England it would be a mere band.

The geographical demarcation between the tract originally called Silurian and Cambrian has nothing to do with the philosophy of the question, for if the axiom of strata identified by their fossils be maintained, is it not clear that the published Lower Silurian types being found to descend throughout the Cambrian or N. Welsh rocks (all S. Wales and its supposed Cambrian having been demonstrated to be physically the same Lower Silurian described to the East of it by the Government surveyors) must give the name to the rocks in which they are found? What does it signify in geological and palaeontological classification that a formation should be 10 times thicker in one tract than in another, provided it contains no new group of fossils? Surely the generalizations of my friends and self ought to have their due weight in this question. Did any one ever propose that the term of Lias should be changed when it was found that the formation was three times as thick and very differently subdivided at Whitby when compared with the first recognized types in the S. of England? Such changes would

lead to interminable confusion, and as I have fairly worked out by a series of inductive proofs, that the Lower Silurian *is the protozoic group*, so most assuredly must the name be adhered to. Fully confident that I shall be supported in this view by English and European geologists who will not permit a name to be taken for *an unknown quantity* which has never been typified and whose relations, on the contrary, have only been made known by reference to my published types, I should deeply regret to see that such an anachronism was introduced on your side of the water. I therefore hope that the strata from the Potsdam sandstone up to the Hudson River Group will be named Lower Silurian as they are by M. de Verneuil and Mr. Lyell.

Having the sincerest personal regard for Professor Sedgwick whose labours have been so blended with my own and who has done so much in every branch of palaeozoic enquiry, the position in which I now find myself (unexpectedly) is one of great vexation. I wish my friend's labours to be thoroughly recognized but not at the expense of the Silurian System. I write this letter in confidence and *not to be noticed publickly*. It is intended *for your own meditations*, and again congratulating you on the impulse you have given and are giving to N. American geology, I remain, my dear sir,

Yours very sincerely,

ROD. I. MURCHISON

The appeal of the Director-general doubtless had its due weight with Hall and this appeal was made very direct by De Verneuil: "I told Mr. Murchison you were rather inclined to apply the name Cambrian to the lower Silurian. It would have been for him a great sorrow to see his system de-

prived of your 400 well defined species. However *I am ready to confess that if it were a new field your lower Silurian in America deserves as well to have its own name as the Devonian System*"; — a suggestion that Hall might well have heeded. Hall did not adopt the Sedgwickian ideas, but neither did he warm to the English classification in any form. His chief purpose was to establish the classification pronounced and promulgated by his colleagues and himself — the New York Series of Geological Formations. He had been witness to the ineffective efforts by earlier American workers to adopt the European category of names for the rocks above the Coal and he was probably conscious that the British geologists had stolen a march upon the New Yorkers. If Hall had expressed with more conviction the major grouping of these New York terms, they might have prevailed in the American nomenclature; they may yet, for their intrinsic merits grow more obvious and their integrity is to their advantage in contrast with the present application of the British names.

Hall, alone in life, felt his isolation and this, I think, made his propositions, where they should have been strong, tentative or rather timid. "Situ-ated," he says in the preface to Volume I, "where I can have no recourse to scientific friends except by letters, with a scanty library of works on Palaeontology and no authentic collections for the com-

parison of species already described, I have been forced to depend upon my own resources in every department."

By M. De Verneuil's visit Hall profited greatly. He was a delightful and great hearted gentleman, broad in sympathy and culture, generous of disposition and most modest in his personality, though always an aristocrat. Those with whom he came in contact long kept the remembrance of his personal charm which is indicated by a letter to Hall from Henry S. Randall, afterwards Secretary of State for New York, whom De Verneuil had visited at his home in Cortlandville, and therein he tells of how, on their trips among the rocks, they mingled their talks on geology with "excursions into philosophy, poetry, history and the arts of France and America." The distinguished Frenchman returned the courtesies he had received from Hall by making him a life member of the Geological Society of France. When he received the first volume of the "Palaeontology" his enthusiastic appreciation takes this expression:

"The different works published in England and Germany are not constructed with the simplicity and harmony which pervades yours. In some respects when you have finished yours you will be more advanced in America than we are in Europe and specially you will have a more easy living for the future. Everybody will disappear before your *royauté* and you will have unity in science. So when you come here, I assure you a triumphal march among our palaeontologists."

Their correspondence continued intimately during the years when De Verneuil was occupied in his researches in Bohemia and Spain. Here follow three of his letters written upon the outbreak of the revolution of February, 1848, and the dethronement of King Louis Philippe. Their lively picture of conditions in Paris and their appeal for help to the ideals of the American Republic give them historic interest. They are printed as they were written.

PARIS, 28 *fevrier* 1848

MY DEAR FRIEND —

I receive just now your kind letter of the last 29 january when our revolution is accomplished 3 days and all our institutions have been overturned, the King and all his family is expelled and the french republic is everywhere proclaimed. All our friends must tend to establish a solid government but we are at a want to know which institution will be most convenient. Everyone agrees that we shall have a republican government but the organic institutions upon which it will be founded are quite in a dim horizon for every mind. A great number are frightened by the institutions of 1793. Our old republic has stained itself with blood and instead of giving liberty to the nation it has given despotism. It is not certain but very probable that the same institutions will produce the same results, as the same tree produces the same fruits. A great number of friends of mine would be disposed to try here the american constitution which is consecrated by long experience. We can not take your federal organization but we would give to france the institutions of one of your states, for instance the one of the state of New York. All these questions will be discussed in our next

national meeting which will take place in one month. Be good enough to let me have a copy of the present constitution of the state of New York and make yourself some remarks on the changes which the last convention has afforded to the old one. Perhaps your old constitution, less democratic than the present, would suit us better. What I require from you as the most important thing is to send me these documents in a letter by the next steamer after the reception of the present. Otherwise it would be too late. [Here follow long discussions of species of fossils.]

Pray, my dear friend, write me as soon as possible and in sending me your constitution of the state of New York or *an abstract of the most important points* be good enough to join some reflexions on them, the result of your meditation or your opinion about the good or evil of your constitution may be for me of a great use. I must conclude hastily this letter and I am, in expecting your answer,

Your most devoted friend

ED. DE VERNEUIL

PARIS, 28 March 1848

MY DEAR MR. HALL:

A friend of mine is going away for America and waits for my letters. I have but a moment to write you and to express to you my thanks for your beautiful work, which arrived here 2 days ago. I have in great haste sent your volume to Mr. de Koninck and the other shall be presented next week to the Geological Society. * * * *

My friend Mr. Marcou is sent by our National Museum to explore the rocky mountains. He is a good geologist and a very kind young man. I have no doubt that he will pay you a visit. He will narrate to you all the great events which shake the whole European frame.

The society is quite in convulsion and God knows whether we shall have again the prosperity and the rapid improvements of our old state. It is said that we are in the middle of a *social* revolution but no one has a clear perception of what is to be done. Meanwhile we are going back of your democratic institutions. Under the name of organization of work the tendency is to destroy the liberty of private industry and to give to the government a monstrous monopoly, the monopoly of every sort of industry. *What a nonsense!* I am very much afraid that the constitution of New York will not be of great use. It will be found far too favorable to order and not enough democratic. Our democrats do not wish to have a president over a senate. You see that they go much farther than you and I fear by that reason that they will never give us any regular government and all our liberties will be destroyed. * * *

Believe to my gratitude

ED. DE VERNEUIL

PARIS 27 November 1848

MY DEAR MR. HALL —

* * * * The revolution of february has shaken a little my fortune. I had many shares in our railways and some of them are reduced to zero. For instance the railway from Orleans to Bordeaux which I paid 300 franc each share is reduced to 12 franc. However these private losses are not so sensible for me as the public calamity. Everything goes ill. The prospect for the winter is very sad and civil war is imminent. The low classes with the workmen of the great towns are quite excited and pretend that they must govern the society for their own and only benefit. The *socialism*, or the war against any man of property is preached in all the clubs, the name of Robespierre is hailed

with applause and the cries *vive la guillotine* are often proffered. Two parties, the socialists or communists and the *montagnardes* proclaim that now comes the end of the old society and the beginning of a new one, not modeled upon the american society but upon a theoretical type where there will be no poor nor rich, but *equal* people. You would be astonished how Pierre le Roux and other socialists speak against the american system where reigns what they call the aristocracy of money or *Ploutocratie*. * * * You have no idea of the stagnation of the products of the commerce of the mind. It is a luxury and no sort of luxury would be allowed by our socialists. * * * I assure you that we have the greatest apprehension. If Napoleon is elected President there will be a civil war because the republicans have excited the population of Paris against him. In such case they say that they will have no respect for the universal suffrage.

Believe me, your most sincere friend

ED. DE VERNEUIL

More momentous for Professor Hall's career was the coming of Louis Agassiz. No advent upon our shores ever brought with it so far-reaching and uplifting an influence upon natural science. Agassiz, in the prime of his enthusiasm, taught in the best schools of Europe, already distinguished for his researches in zoology, came as an expounder of the philosophy of his science, primarily to deliver the Lowell lectures on the Plan of Creation. But he brought with him the hope that the New World would open out to him a larger opportunity. These active studies and researches in Switzerland,

Germany and England had brought him no secure income and in plain terms, he needed money. Through the friendly offices of Humboldt he had gained the financial support of the king of Prussia for a two years' trip in America and by the help of Lyell's influence with Mr. Lowell, he secured the highly remunerative lectures at the Institute in Boston. For a long time his friend, Charles Bonaparte, Prince of Canino, the American ornithologist, had pleaded with him to come over. Not only was Agassiz versed in all the branches of zoology; he had written a monograph on the *Poissons fossiles* of the Old Red Sandstone and other formations; had attained eminent distinction for his studies of the physics of the Alpine glaciers in which he was helped by Arnold Guyot, and was, in fine, of so broad appreciation and experience as to be directive in many fields. Not his advent, but the decision to remain was after all the real significance of this episode. Agassiz's history, his influence, his inspiration, have been the subject of many memorial tributes; his biography has been written more than once, but in all these records of him little appears of his relations with Hall. Indeed, in Mrs. Agassiz's two volume "Life and Correspondence," Professor Hall's name appears but once; and yet here is a shock of letters which passed between the two and cover a period of more than twenty years, many of them of intimate char-

acter and some of unrecorded worth to the history of American science.

Professor Agassiz arrived at Boston in September, 1846, and as his lectures did not begin for a couple of months, he made his way to Albany by as short a route as the Boston and New Haven men would permit. His reception was little short of a *furor*; his coming had been announced again and again and for a year Silliman had been telling Hall of the date of his arrival; in the autumn of 1845, in the spring of 1846. When he did get here he made a profound impression, not alone with his great stores of knowledge, but with his inviting and gentle personality, to which, beyond any doubt, his "pretty" English, as Lady Lyell called it, added an attractive glamor. Augustus Gould exclaims to Hall from Boston: "Agassiz! Agassiz! Wonderful! Inspired! Privileged are we to enjoy his instruction and his example." And Benjamin Silliman, Senior, his host in New Haven, writes: "Have you seen Agassiz? If not, I can promise you a rich treat in him. He is full of knowledge on all subjects of science, imparts it in the most graceful and modest manner and has, if possible, more of *bonhomie* than of knowledge. He has a more minute knowledge of his subject and at the same time a more wonderful generalizing power and philosophical tone than any man I have ever met. He spent two days and three nights with us here

at my house and it is not yet agreed whether the Ladies more liked the *Man* or the Gentlemen more admired the *Philosopher*."

And while Silliman was writing this, Agassiz was on his way up the Hudson to Albany where lived Hall, the man of whom he had heard so much from Lyell, Murchison and De Verneuil, and where was published the great Natural History of New York; "2500 copies of a work in sixteen volumes quarto" he exclaims in his "Letters," in the intervals of his delight over the beauties of the river, "scattered throughout the State of New York alone! When I think that I began my studies in natural history by copying hundreds of pages from a Lamarck which someone had lent me, and that today there is a State in which the smallest farmer may have access to a costly work worth to him a library in itself, I bless the efforts of those who devote themselves to public instruction."

"I have just caught the big fish Agassiz," writes Professor Bailey from the West Point Military Academy, whom the visitor had stopped off to see, and he sends on word that he hopes "to pilot this scientific whale" to Albany.

In the introduction of his Palaeontology, Hall acknowledges the help he received from Agassiz's counsels and so, notwithstanding that the two were men of widely different experiences, Agassiz in touch with all that was being done in his world and

Hall, as he has said, in solitude among his books and specimens, there sprang up between them at once, a friendship and a bond of helpfulness which, as we may see, lifted Hall out of some of the sloughs into which his temperament was forever getting him and which would have precipitated Agassiz into like places had he been less buoyant. Shortly after Agassiz's coming, Edouard Desor arrived to act as his secretary and he made up in some measure the shortages in Agassiz's geological experience; and of these men we may here take only this preliminary glimpse. Their active participation in this history belongs to other chapters.

Meanwhile Ferdinand Roemer has come and gone, 1842. Roemer was a young doctor from Bonn, out for his wander-year to Texas where he spent eighteen months in pioneer work among the Cretaceous rocks. He wrote his book⁷ which was a rather pale contribution to American geology, but his real interest then and thereafter lay in the study of the palaeozoic fossils⁸, a field of knowledge to which he succeeded in later years at Breslau, making uninspired contributions, without revealing a gleam of the principles or philosophy of his science. Roemer came to Albany and under

⁷ Chalk Formation of Texas.

⁸ Subsequently he published a work on the Silurian fossils of western Tennessee, a work which would have been better, if less hastily done.

Hall's guidance greedily assembled the New York fossils from the nearby localities of the Helderbergs and Schoharie. Thirty-eight years after, we find Roemer urging Hall to send him the fossils that he collected on this visit to Albany!

Before we close the record of this period there are other contacts which should not be passed over. After the end of the Fourth District work, Dr. E. S. Carr, Hall's field assistant, had been serving as Professor of Physiology in the Medical College at Castleton, Vt., and in 1845 he wanted to be State Geologist of Vermont. Emmons, it appears, desired this position. Doctor Carr begged for Hall's endorsement. Hall was in a quandary; he owed all his support to Carr, but would have been very willing to have Emmons go to Vermont. Beyond any doubt he could have brought about a decision of the matter if he had cared to venture, but this time he kept out of the contest and, perhaps as a result Charles B. Adams,⁹ a conchologist of great merit, who had the support of Professor Edward Hitchcock of Amherst, was appointed. Doctor Charles T. Jackson, versatile, ireful and "diffi-

⁹ Professor Adams did not bring his work in Vermont to full conclusion. It proved too arduous for his delicate physique and he retired to Amherst where he took over the Department of Natural History and Astronomy, but his health soon made it imperative for him to seek a milder climate and he passed the remaining years of his life in Bermuda. He was a diligent conchologist and a great collector; the Adams collection of recent mollusks has long been one of the important scientific assets of Amherst College.

cult," was also a disappointed candidate for this position and was unsparing in his denunciation of the appointment, the appointee, the appointors, the State of Vermont and the State of Science generally; but his American colleagues were used to his outbursts.

When Colonel J. C. Frémont, the Pathfinder, returned from his Exploring Expedition into the remote regions of Oregon and "North California" he brought the first fossils obtained from the rocks of that distant country. All that he had managed to save when fourteen mules with their loads fell over the canyon cliffs and such of the remainder as had escaped the floods of the Missouri, came into Professor Hall's hands for study and report, and his illustrated observations, published in 1845 in connection with Frémont's official report, are today historically important as the first records of Mesozoic life from the far-away Mountains and Great Plains.

It was natural now that every movement in geological science in the country should come close to Hall. His prestige was very great and still in the ascendant. Whatever these movements were, in State or Nation, they sought him out, or if they did not, he sought them out, for he was quick to let no opportunity for enlarging his knowledge, his service, his control and his collections slip by. His knowledge was already extensive and varied, his

service of great worth and his collections of fossils were beyond question the largest and best in America; indeed his series of palaeozoic fossils probably best in quality and variety of any extant.

In 1847, some of the citizens of Mississippi had felt the lure and the need of a State geological survey. Almost simultaneously Hall received letters from two citizens in different parts of the State, which give an interesting picture of how this scientific problem presented itself to the Mississippians. M. W. Philips of Log Hall, Edwards, writes first to Hall in care of Luther Tucker, of Albany (editor and founder of the *Country Gentleman*), to the effect that a few citizens were intending to raise privately a subscription — “\$2,500 or \$5,000, to be placed in the hands of one or more trustees for the purpose of securing the services of the best geologist that can be procured, the amount being given him as a bonus to serve the State.” This “best geologist,” it is very emphatically pointed out, was to be a *gentleman*, and was to make what he could out of the provision, though the hope was expressed that he would be content with the smaller sum. It was not very clear to the writer just what a geological survey might involve but it was thought that it should be sufficiently agricultural to include by counties, a statement of the number of acres in cotton, corn, oats and potatoes; “how many slaves, how many negro children born, pro-

portion of sexes and ages on each plantation; number of horses, brood mares, colts reared," etc., etc.; "in short, every species of information."

Directly follows a letter from the Rev. R. Morris, of Mount Sylvan Academy, principal and postmaster, (now College Hill, Lafayette county) who tells of his plan to give a course of lectures on geology "by appointment" to the legislature, and he seeks Hall's aid and publications. To these two approaches, one from the south and one from the north of the State, Hall brightens at once and to both, each obviously unknown to the other.

Both, in their replies, are suffused with patriotic enthusiasm. Says M. W. Philips:

"The South, my native home, my own Sunny South, can not, in all her lovely clime show a better specimen of a Southerner than I take you to be. Understand I am a native born South Carolinian and have all the pride of State that any of these have. I have no money, no talents, but I have better than all [it appears from the letter that he was laid up with inflammatory rheumatism], a fond inspiration to do something for the good of our race; and though a Southerner, though a Mississippian, though a citizen of this bankrupt State, a repudiator and one proud of being all this, yet I would not for my right arm, endeavor to build up my State at the downfall or prejudice of another. I am a Southerner of no clime, a citizen of the U. S. without a local habitation when the amelioration of my race is concerned."

These "highfalutin" sentiments with their agricultural preface did not impress Hall; but mean-

while Mr. Morris shows how cleverly a plan for a State Geological Survey had been instigated and developed between Mount Sylvan and Albany:

"The State election comes on next week," writes Mr. Morris. "We are prepared to send to each Member for the Legislature who is elected a notification of *his election to an honorary membership in our State Geological Society*, and shall follow it up with such circulars, newspaper publications etc., as may be needed to give them a little insight into the importance of geology to State interests. By this means they will be likely to be worked upon somewhat favorably. The Governor is to speak pointedly on the subject in his message and certain influential Gentlemen will then use their *lobby* influence (no trifle in this country) to get an appropriation for a Survey. We *who know Mississippians*, think that we can effect the object by these plans."

"And now, my dear sir, supposing that we succeed, will you come down with the presage [!] of your name and your enterprise and science and let us make it a useful thing? Can you come in advance of our success and deliver an address? But you fear that would look like soliciting office and you Northerners are very sensitive about that! * * *

"This letter shall be confidential or if you are a Freemason (as I hope you are, for every clever fellow here is one), *on the square*. It is quite likely that Professor Tuomey will be spoken of, but *we* want *you* and we will carry the day or it shall go hard with them."

It all came to naught. The promise was too unsubstantial for Hall and Dr. Merrill has pointed out that the combination which ensued between State and University was not helpful to a knowledge of Mississippi geology.

CHAPTER VII

THE PALAEONTOLOGY OF NEW YORK

THE PERIOD OF VOLUME II — 1847-1852

1

Appreciation of Volume I — Troubles and anxieties — Plans to leave Albany — Defense of his work — Quality of Volume II — Intimacy with Agassiz — American Geological Museum — Agassiz lectures at Albany — Influence of the Scientific Survey — University of Albany — Its organization — Scientific Faculty — Polytechnic School in New York — A National University — Collapse of the University of Albany — Dudley Observatory — Albany Law School.

PROFESSOR HALL had now finished his first volume of the Palaeontology and got his momentum. He had created a new kind of book for America, and had entered with unexampled elaboration upon a new field. Compliments and congratulations came in from all sides. The Boston coterie, Gould, Agassiz, Horsford, Bouvé and Cotting were full of intimate applause and so were his working colleagues in geology, the Sillimans, the Rogerses, Samuel G. Morton, Halde-
man, Jacob W. Bailey the expert student of infusoria at the West Point Military Academy. More even than these assurances of labor well done, the

honor which Hall had brought to the State elicited for him the active support of many of its very influential citizens. Thomas W. Olcott, president of one of the Albany banks and always an active promoter of the intellectual life of the Capital, speaks of him as a "prince in his profession" and adds "I am assured by an intelligent gentleman who has just returned from abroad that there is no geologist in this country, whose writings are more eagerly sought for, or whose opinions have greater weight throughout Europe than Prof. Hall's." He inspired Ledyard Lincklaen, a wealthy and influential citizen of Cazenovia, and Henry S. Randall, afterward the Secretary of State, with intense zeal for collecting fossils. Indeed his work seems to have lifted the veil for a new and fascinating scientific diversion and palaeontology was now pursued *con amore* in intellectual centers all about the country.¹ The first volume of the Palaeontology was a wedge well entered now, but Hall was to find that it was still hard to drive, and in getting his work so well under weigh he had also acquired, through high pressure and the anxieties of a

¹ The "North Country," the region skirting the Adirondacks, was specially fruitful in the fossils of the "Lower Rocks" and produced many vigorous collectors, both men and women. A physician well known in his locality caught cold on one of his collecting trips and died. His widow writes to Hall: "Alas, his zeal in scientific work cost him his life, leaving his widow and children without a head." Palaeontology is indeed at times a two-edged sword!

slender income, a set of overstrained and jangling nerves. And some of the comments of his colleagues had their reservations. He had accomplished a quite extraordinary feat in the mechanical treatment of the book, for the drawings of his fossils were made by Mrs. Hall and her sister Mrs. Brooks, who understood their subjects, and the plates had been rendered in lithography of a very good quality as lithography went in those days. But Silliman tells him his lithographs are utterly bad and not to be compared with the illustrations of some of the recent European works. Silliman was rather rude but his corrective was timely, and Hall, sensitive to all but praise, immediately betook himself to Agassiz who had conducted a lithographic establishment in Switzerland and now proposed to bring over for Hall's service one of his own workmen, Sonrel, whose exquisite workmanship added much distinction to Agassiz's own publications. Failing here and despairing of any improvement in lithography, after many tribulations over it Hall determined that for his new volume the plates should be engraved on steel; and, for the most part they were. This rendering vastly improved their quality but enhanced their cost. But before he had got so far along as this Hall, with all his nerves thrumming, was for abandoning the whole undertaking. First he thought of accepting a professorship in the University of Alabama,

which had come his way; then he would like to be State Geologist of Kentucky, and presently he had a severe attack of the gold fever and would join the "forty-niners" in California. He appealed to Joseph Henry for appointment as geologist on a proposed United States Exploring Expedition to California. Henry replies (December, 1848) that there is not to be any, but that Lieutenant Gillis is going to Chile on an Astronomical Expedition and thinks he might get for Hall the position of Naturalist. In a postscript Professor Henry adds that he is informed by the Hon. Butler King² "that a geologist will be sent out with surveying parties for the purpose of making an exploration of the Aleutian Islands for the discovery, if possible, of any coal fields which may exist along the route to Japan"; and suggests that Hall might like to go along in that capacity.

He would have none of these things and his letters to Lyell, Agassiz, Horsford and his other correspondents are full of melancholy ululations and elicit sympathy in plenty except from his Boston friends, Gould and Kendall, who lecture him without mincing words and help to bring him to his senses again.

"Dismiss your California schemes" writes Augustus A. Gould. "Determine at once, live or

² T. Butler King, then Representative in Congress from Georgia, was a member of the Naval Committee.

die, to stick to your Palaeontology until completed. This you owe to your own fame, to New York State, to science and to us all." Hall had no other intention. Horsford tells him that if he goes so far away he will lessen his chance of a call to Cambridge and thinks that the completion of his "Silurian System would be glory enough for one man."

Many of his doings were vastly comical. He wanted possession of a back room in the Old State Hall, where he could open up his boxes of specimens, but he could not get it as it was occupied by Mr. Gebhard, custodian of the State Cabinet, and Dr. Beck, as secretary of the Board of Regents in charge, refused to give it up. Whereupon Hall indites a letter to Senator Nelson J. Beach, of four finely written quarto pages in which he states the case and then calls heaven and earth to witness that he is a much abused man; scolds the Regents, declares that an effort is being made to get rid of him, and then audaciously and with most unaccustomed vanity for him, declares that "The State of New York is publishing a work on the Natural History of her territory which is exciting more attention at home and abroad than all else she has ever done. The man who laid the foundation of this work has earned for himself a reputation undying"; and he then precipitates himself: "Let me cite a single case" he says; "While Professor

Agassiz remained in Neufchatel every eye was directed there to learn from him, as the master, what were the laws, the facts and the results in most departments of zoology. The collections of Neufchatel bore the stamp of authority and the place, though comparatively an obscure one, was the center of advancement in science. Professor Agassiz is no longer at Neufchatel but at Harvard University and where now does the world look for the advancement of natural history and the promulgation of laws before unknown? Not to Neufchatel but to Harvard University where science is to take the lead of all the world. Now, sir, New York has made progress in all the sciences but in geology she stands preeminent and her localities will be classic ground for centuries to come. But the sceptre may depart and I say unhesitatingly that the course likely to be pursued [by the legislature] will prevent any further progress and in all probability New York will be, fifty years hence, just where she now stands, while Science will have made mighty strides and the vantage ground she now holds will be given up; indeed, thrown away from mere ignorance and ill-nature." (Letter of November 20, 1849.)

The Senator was impressed, not offended. He wrote reassuringly and thereupon Hall tells him boldly how he violated his contract with Governor

Bouck "for the better service of Science"; gleefully declares that the Legislature encouraged him in doing so and then gives a detailed estimate of the number of quarto plates of illustrations he would require to complete the *Palaeontology*. This number, he pointed out with some argument and detail, would be 250. The number actually made in the completion of the work was 770.

I think the condition of Hall's nerves is registered in the quality of his work at this time. Volume II, which was the equal in size of Volume I and of superior mechanical treatment, is not as acute and thorough an analysis of his subject. Indeed, it is obviously conventional in its descriptive matter and is lacking in the broader discussions which added much of worth to the first book. It has always seemed to me as though its distinguished author set to himself the prescription of describing at least one species before breakfast and one before going to bed, leaving the rest of the day for what we may euphemistically call "playing on his harp of a thousand strings." I would not intimate that this second volume, which was devoted to an account of the extinct life of the Silurian System in New York — the Oneida, Medina, Clinton, Niagara and Guelph formations, was not an extraordinary production. It was. It was again a pioneer work, the first unveiling of the life pano-

rama of the true Silurian.³ It was comprehensive and perhaps even more exhaustive and complete in its record than its predecessor. The beautiful fossils of the Niagara group were delineated with minute accuracy and few more magnificent illustrations of such objects have been presented than his wonderful figure of the great Niagara trilobite, *Platynotus Boltoni*. No one since has written an equal or similar book on this theme for the reason that none has been needed. As Agassiz wrote, "It must be indispensable to all our geologists as long as our Silurian rocks exist." I recall, when, in 1894, the thirteenth and last of all the volumes of this Palaeontology of New York was finished, Professor Hall saying: "For many years I have wanted to revise my Volume I, so much has been added to our knowledge of these early faunas"—and at 83 years of age he seriously wished me to plan the revision of a work he had completed 57 years before! But he never made such comment regarding the volume on the Silurian, for the excellent reason that there was no occasion for it.

We have intimated that the beginning of Hall's acquaintance with Agassiz was the entry into a new and, as it proved, active and influential sphere

³ The title in full was: Palaeontology of New York, Volume II. Containing Descriptions of the Organic Remains of the Lower Middle Division of the New York System (Equivalent in Part to the Middle Silurian Rocks of Europe).

In a manly way they fell in love with each other from their first days together in Albany, to which we have already referred. Hall had a compensation of knowledge which Agassiz lacked and needed and Agassiz in even greater measure contributed to make Hall more proficient in his own science. Both were high-minded men of the most generous impulses, with hearts set without reserve in service to science. To Hall's minor key Agassiz set a harmony of genuine fraternity. Agassiz's first letter after his return to Cambridge from Albany says:

"Will you excuse me for not having written sooner as I ought to have done? But if you consider the excitement into which a foreign naturalist is necessarily carried by seeing every day so many things entirely new to him, you will easily understand how difficult it is for him to command his time. Since I had the pleasure of meeting you in Albany, and delightful days they were, I have scarcely had a moment's leisure, the market supplying me daily with fishes and fowls of all kinds and the demonstration occupying all my time besides.

"I anticipate very great pleasure and instruction from my next visit to Albany when I expect to stay some time with you. As I have only delivered a few of my lectures I am not yet able to say how far I shall be able to repeat them this winter for fear of undertaking more than can be consistent with my own scientific researches, but as soon as I have gone through, I shall let you know. Could you in the mean time tell me what kind of trouble it would give me to arrange such a course of lectures in Albany?" (September 20, 1846).

Soon again he writes (Dec. 29, 1846):

"You can easily imagine by my deficient English that my lectures give me much trouble and make me lose much time, nevertheless I am happy to see that the people here are pleased with them and attend in great number very regularly, so that I have in this respect every reason to be highly satisfied. The one which might perhaps interest you most is that on "Geographical Distribution of Animals" which I shall repeat the last evening, next Monday fortnightly. The three next before the last will be on the "Successive Introduction of Species in Geological Times." It would give me the greatest pleasure to see you here at that time or at any other time, and at all events again in Albany when I anticipate much instruction from Geological excursions with you."

The Albany lecture was to come, with what results we shall presently see. Meanwhile in 1847 Agassiz had accepted the Professorship of Zoology and Geology in the Lawrence Scientific School. "It is obvious," says Horsford to Hall, "that the professorship was created for him." "The Professor is well and busy as ever," writes Gould later in the year, "too busy I fear to render the realization of my hopes to produce a book speedily very encouraging [Agassiz and Gould, *Principles of Zoology*]. He has commenced a course of lectures on the Alps and their phenomena and has a crowded hall. We intend that he shall pocket \$1000 by it."

These two men, Agassiz and Hall, had not long had their aspiring heads together than great projects began to develop. Agassiz, now fortified in his new professorship and alert for every opportunity to develop his visions, projected at once a National Geological Museum at Cambridge, and as Hall had what was then probably the largest geological collection in the United States, he was to take his collection to Cambridge and go with it to a professorship in the College. Professor Hall, always in financial straits because he spent too much money in swelling his collection, had repeatedly tried to borrow and to sell, indeed he is constantly soliciting aid of his friends for the one purpose or the other, and the suggestion from Agassiz that he would raise money to buy it for Cambridge seemed at once to solve some of his troubles and lighten his spirits. The thought, too, of going over to Cambridge to join the brilliant coterie now gathering there was dazzling. So Hall listened intently.

Horsford writes in March (1847) that he and Agassiz are trying to induce Mr. John A. Lowell to furnish money for the double purpose, and Agassiz has already written to him (January 1848): "I feel happy to be able to tell you that in considering the plan of an 'American Geological Museum' I have not the slightest selfish view, neither for me or for any of my friends and if the

matter could be arranged so as to induce you to leave Albany and to be connected with the College, I would with all my heart concur in the plan. And if such a Museum be founded and you are inclined to lay such a broad foundation for its future increase, no one will be more ready to secure to you all the credit you will deserve in devoting your attention to it. Let me add, to be fair in every point, that I had also thought of mentioning Mr. Dana as one, if connected with the College, who would contribute to increase its lustre. I thank you for your confidence and openness. Let scientific men be straightforward and they will conquer fully the esteem of the public and be better able to *guard the great work of civilization which is entrusted to their care.*"

This splendid project for an American Geological Museum which was to bring together in Cambridge the superlative geological talent of the country, determined herewith. Agassiz was dealing with a man who, though gravely tempted by the dazzling prospect of distinguished association, of honor with peace and compensative ease, never, in the bottom of his heart, entertained the slightest intention of leaving Albany and his Palaeontology of New York. Hall's experience in later years, amongst his oft recorded lamentations that he had not gone here or there or responded to some other alluring invitation that would have divorced him

entirely from New York; these show that wild horses could not have dragged him from his work. His battlefields were his glory; the smell of them was in his nostrils and he loved the fray which brought him the joys of victory.

Knowing all this, conscious of his powers and his repute, as well as of the standing which Albany, the seat of New York State Science, had acquired, there were other and deeper purposes buried in his thoughts.

In the spring of 1848, Hall endeavored to induce the Young Men's Association of Albany to arrange a course of lectures by Agassiz, but the arrangement did not go through very successfully and only one lecture was provided for. Somewhat mortified at this treatment, Hall went out among the men who stood for the intellectual life of the city — Thomas W. Olcott, Ezra P. Prentice, Justice Amasa J. Parker, Judge Greene C. Bronson, Amos Dean, Luther Tucker, Dr. James M. Armsby and others, and with their support provided at once for a course of five lectures by Professor Agassiz, which were enthusiastically given and received. This was not a mere exchange of courtesies on the part of Hall. He did indeed go over to Cambridge and give his "Harvard Address," but it was obviously not a great success and he himself speaks of it as "my dying speech." Meanwhile, as Hall would not go to Agassiz and Cambridge, he was,

with Agassiz as a text, talking to the Albany people of this great intellectual center that had risen about the Natural History Survey, the possibility of bringing Agassiz to Albany with a faculty of leading men of science which in conjunction with the Medical School, long established and successful, and with the powerful influence in agriculture wielded by Luther Tucker through his paper "The Country Gentleman," should constitute the essentials of a great University. Little by little the heaven wrought; interviews led to conferences among these men and conferences to open meetings, until the University idea took firm hold and concrete form. News of the project got abroad, excited widespread interest in other centers of education and presently, indeed, no little emulation.

During the summer and autumn months of 1850 correspondence was lively over the selection of men for the scientific faculty. As early as January, 1851, Amos Dean sends to Hall notice of "a meeting of the professors of the University of Albany at the house of the Rev. Dr. Mandeville," and we may assume that there convened in response to this notice, with Professor Hall, Professor George H. Cook, then principal of the Albany Academy and afterward to be the State Geologist of New Jersey, Doctor Ebenezer Emmons, "Professor of Obstetrics and Natural History[!]," and Doctor Lewis C. Beck, Professor of Chemistry and Phar-

macy, both of the Albany Medical School; with Judges Ira Harris and Amasa J. Parker, representing the new Department of Law, and apparently Professor Agassiz had come over from Cambridge to address this meeting. No time was lost in incorporating the new university and the "Act to Incorporate the University of Albany" passed the legislature, April 17, 1851.⁴

It was to be an institution "for the purpose of promoting literature and science"—"literature" standing first though it fails to be indicated in any subsequent public papers unless it was absorbed into and implied by the department of "law."⁵

Meanwhile correspondence went on over the organization of the scientific faculty, accompanied by the effort to raise money for the project. Agassiz is in grave earnest even to the length of sacrifice. He writes under date of August 3:

⁴ The trustees of the university named in the Act of Incorporation were forty-nine in number, all substantial professional and business men of Albany, a multitude who held high the intellectual prestige of the State. Among these men may be mentioned Judge Bronson and Ezra P. Prentice, strong friends of Hall and Horsford; Judge Ira Harris, Justice Parker (who was to preside at the trial of Agassiz), Robert H. Pruyn, James Kidd, Rufus H. King, Christopher Y. Lansing, Thomas W. Olcott, George Dawson, Luther Tucker and Nicholas Hill.

⁵ The syllogism is an easy one: The university was chartered to promote *literature and science* only; it did promote "law"; "law" is certainly not science, indeed *alpha lyrae* is not more remote; therefore "law" is literature.

" You know how my whole soul is bent upon the project of an American University and what sacrifices I am ready to make if I can contribute to bring it about in any way. You know, however, also how limited my means are, since I have always been unwilling to devote any more of my time to other labors except scientific original investigations than is strictly necessary for sustaining my family and carrying on my researches. You know I have done this to such an extent as never to have before me in advance even the means of living for one single year. Now the winter season approaches and I must make sure of my budget. How does the plan in Albany stand and what have I to expect from the Trustees? This is a question which I have not yet asked and which I would not have asked before the meeting were it not for a proposition which has just been made to me and which I feel bound to accept until the plans of our University are so matured as to secure success. A subscription has been raised in Charleston, S. C. by the friends of the Medical College to offer me \$2,000 a year for four successive years, on condition of my delivering during my winter vacation a course of lectures on comparative anatomy to the medical students of that institution. Are the prospects in Albany such that I can be justified in refusing such a proposition? I would repeat that there is no reasonable sacrifice which I am not ready to make for the establishment of an American University, or an institution which would assume such a character as to supply the want under whatever title it be; but as I have already said in Albany before the Trustees of the University, it cannot be expected that private individuals should bear the risk of such an undertaking. It would be just as reasonable to expect that common schools were provided for by the teachers themselves.

I wish you would see Mr. Olcott about this matter. I prefer to write directly to you, than to him, as you may give him some more explanations about myself than would be proper for me to write, and perhaps nobody but you will believe what are really my resources and how carefully I must manage to meet the two ends of the year.

My love to Mrs. Hall, also from Mrs. Agassiz. She has made up her mind not to come to Albany; the fact is that we have not the means of making even this little extra expedition."

Hall writes to Prof. Jacob W. Bailey at West Point with the hope of securing Professor Dennis H. Mahan⁶ for the Engineering Courses and asks Bailey's advice regarding Lieutenant Benjamin Hall Wright of West Point for a similar place on the faculty. John P. Norton of Yale joined his interests to the project and agreed to come as Professor of Chemistry; Professors Ormsby M. Mitchell⁷ and Benjamin Peirce, astronomers of national prominence, were already taking a lively concern in the undertaking and in their frequent conferences with the Albany trustees aroused great enthusiasm over the desirability of an astronomical observatory in connection with the University. By

⁶ Among the most distinguished of American engineers; father of Capt. A. T. Mahan, writer on sea power and other naval subjects.

⁷ Professor Mitchell afterward became director of the Dudley Observatory. Being a West Point graduate, he entered the Civil War, where he won the commission of Brigadier-General but died of yellow fever.

October, Professor Peirce has worked out the whole project, faculty and all, and he writes to Hall:

“It will be indispensable for the first ten years for private individuals to guarantee the funds which will be required to maintain the University, but I regard it as the part of the Professors to render it so grateful to the pride and so attractive to the good will and good sense of the State that the Government will after that period send pupils enough to insure its permanent establishment, but this hope can not be attained unless the corps of Professors is sufficient in number and quality to command universal respect and confidence.

The following is the list of the Professors which I should propose and which I have written in alphabetical order taking the liberty to insert my own name for convenience of reference.

Agassiz — Zoology; Dana — Mineralogy; Hall — Geology; Lovering — Physics; Mitchell — Astronomy; Norton — Chemistry; Peirce — Mathematics; Wright — Engineering; Wyman — Comparative Anatomy.⁸

Most of the Professors will only be required to be present at the University and lecture daily during three months of the year, in which their salary should be \$1,500 per annum. In addition to this sum Hall and Wright should receive \$1,500 so that the whole salary of each of them may be \$3,000 and their services may be proportionately augmented. It is of the highest importance that Agassiz and his collec-

⁸ That is, more explicitly; Louis Agassiz of Harvard, James D. Dana of Yale, James Hall, Joseph Lovering, professor of physics at Harvard, O. M. Mitchell, John P. Norton of Yale, Benjamin Peirce of Harvard, Benjamin H. Wright of West Point, Jeffries Wyman of Harvard.

tions should be transferred permanently to Albany. He should be provided with the means of increasing his cabinet and be relieved from the necessity of lecturing about the country. He should therefore, in addition to the salary for lecturing, receive \$2,500 per annum."

And Hall writing to Agassiz, October 27, 1851, tells of this letter, of Mitchell's enthusiasm and of other things which happened at a public meeting in Albany:

"Prof. Mitchell returned home on Wednesday last, with Prof. Peirce's letter. The letter is very gratifying to our friends here, though they fear that the money for the experiment can not be raised. On Wednesday evening we had a meeting of some two hundred individuals and Prof. Mitchell addressed them on the subject of the Observatory and followed by some very appropriate remarks upon the plan of the University, reading the first part of Prof. Peirce's letter and telling them in conclusion that if they, the people of Albany, could not raise the money for such a grand experiment he himself would. He was followed by several others and among them Mr. Randall⁹ who spoke in warm terms, hoping the object would be carried out as the climax of the educational system of New York. Others followed and finally Dr. Beck¹⁰ who had been called on to preside at the opening of the meeting, said that although not accustomed to speak on such occasions he would say a few words. He said he had been doubtful of the success of this University; he thought when first proposed that it would add another to the already too numerous colleges, but he had

⁹ Samuel S. Randall, Deputy Superintendent of Public Instruction; witness in the Agassiz suit.

¹⁰ T. Romeyn Beck, M. D.

become convinced that those engaged in it had a higher object and he believed the plan would be carried out and that we might have in Albany a university equal to European universities and become in time equal to the celebrated University of Berlin.

This speech was followed by great applause, and being made pending a motion to adjourn, the meeting adjourned having been occupied about two hours."

There was reason for this great enthusiasm on the part of Peirce and Mitchell, for their influence had already been so effective that through the cooperation and direct intervention of Thomas W. Olcott and Dr. Armsby, a sum sufficient to build an astronomical observatory had been secured by the gift of Mrs. Blandina Dudley. Professor Norton was doubtless telling Hall old news when he wrote (June, 1851): "You will be pleased to learn that Mrs. Dudley is to build the Observatory. This probably will secure Mitchell. I enclose a copy of the new circular. We shall send 4000 of them to the State Fair." But before this gift had been made the "Circular of the Scientific Department; University of Albany; Courses of 1852" was out and distributed; and hereon the scientific faculty as made up was:

John P. Norton, *Scientific and Practical Agriculture*.

James Hall, *Geology with its Applications to Agriculture* (16 titles!).

O. M. Mitchell, *Astronomy*.

Henry Goadby (formerly of the Royal College of Surgeons, London), *Entomology in its Relation to Agriculture*.

George H. Cook, *Elementary Chemistry*.

George R. Perkins, *Applied Mathematics*.

To these lectures was attached a fee varying according to the length of the course, and with these science courses were coupled those of the departments of law and medicine. The two latter gave a training for a recognized profession and livelihood and were evidently successful; the science courses did not afford such opportunity for entry to any recognized profession and appear to have been given only in part. It was expected that the State would come to the help of the University with a generous provision for scholarships but it failed to do so and thus failing deprived the science department of its chief reliance.

The failure of the 1852 courses did not wholly discourage the sponsors for the University nor lessen the general interest in the project of a national university of broadest scope. It was, it seemed to those behind it, only a little slow in getting in motion and in realizing its proper scope.

Desor, the Swiss naturalist who had come over to be associated with Agassiz, believes that it holds out a good hope for the country and seeks a definition of its purpose. "What," he writes, "should an American university be? Must it be on the

English, the German, the French or on an American plan? Must it grow up from the Common schools without any seed being sown or must it descend from on High like a new revelation? Must it be, as now proposed in England, a mere graduating institution producing its results wholly by examinations; or must it be a collection of professional schools? Or should it be a school in which the higher education is to be given to all men desiring a liberal education? Must it fit its pupils for heaven or for earth? for the world as it is or as it will be or as it should be? Shall its sponsors be pious monks, learned scholars or wise and efficient men?"

At this point of our story a new character enters; a keen young blade by the name of Josiah D. Whitney, of Northampton, Mass., one of the "Cambridge crowd," as he himself calls it, and the writer of breezy letters, often serio-comic but quite as often intensely sober-minded whenever pursuing his scientific concerns. We shall presently see that Whitney had already come into Hall's life in connection with the Lake Superior mineral survey and was a man of recognized ability in his profession, though he had not yet gone far. The talk of the Albany University had spread afield; it proposed to take from Cambridge some of its brightest lights and the unelect at Harvard seem to have deliberately started a back fire to prevent this

depredation; as witnesses this characteristic outburst from Whitney (January 1851):

"I was at Cambridge yesterday and sat four mortal hours hearing the sophs' examination in the elements of chemistry by the illustrious Prof. C—. I did not find that his appointment seemed to give very extensive satisfaction there. He may be said to have bought his professorship for \$1,000, having offered to lay out that sum for apparatus for the college. Going-going-gone at \$1,000! Don't I hear any more? Only \$1,000 for a professorship in the most ancient and respectable college in the country and formerly filled by so distinguished a man!

What do you think of a Polytechnic School in New York City with Messrs. Hall, Gibbs, Gould etc., for professors? Such an idea is being discussed in Cambridge."

A few days later he writes again, of which the following is an abbreviation:

"I spent Sunday with Gould and talked the matter of the Polytechnic School over with him. He is going to New York and Washington tomorrow and will take an occasion to discuss the thing with Gibbs and others. We are strongly inclined to New York for many reasons. 1. The great city itself and its various advantages. 2. The Astor Library. 3. We all want to be established there where in case of need we can have other engagements to make a living from. This is especially the case with Gibbs and Gould. 4. The opportunity of establishing an Academy of Science."

Soon again:

"With reference to the P. S. * * * we proposed the following departments:

Gibbs — Chemistry and Physics.

Whitney — Mineralogy, Metallurgy and Mining Engineering.

Hall — Geology and Palaeontology.

Chauvenet — Mathematics.

Gould — Astronomy, theoretical and practical Engineering.

If such a school is organized we shall have only the best men in the country. Nothing is decided as it is only a matter that we have talked about in our utter disgust of the way things are done at Cambridge."

In the absence of any response from Hall to these letters we may assume that his interest lay elsewhere. So Whitney goes to Europe but by September he is back again and interested in the Albany undertaking. He writes in January, 1852 from Northampton:

"As for the University, it seems as if it had fallen altogether in the hands of the old fogies. A pretty piece of business such men as Whalen, Bishop Potter and T. Romeyn Beck will make of the organization. What a scientific spirit was shown by the Rt. Rev. Bishop in his lectures in Boston when he laid it down that there were physical and physiological phenomena which it was a sin to investigate!"

This in February:

"I agree with you entirely that it will take something more than a flourish of trumpets or beating the big drum to make a University and when the big committee comes together to draw up a plan I trust that they will be furnished with nothing in the trumpet line larger than a penny whistle, but that they will roll up their shirtsleeves and go to work in earnest. We have talked until our throats are tired and now would like to see something done. We are lying on

our oars now and waiting to see what will come to the Albany movement. Certainly such an undertaking is a National matter and not to be hampered by narrow-minded local prejudice. We are determined to do what we can at Cambridge if things do not go right at Albany."

And this in April:

"I hope that you did not expire with the Albany University and I also hope that you have not allowed yourself to be prejudiced against me by the infamous falsehoods which J—and his friends have caused to be communicated in order to prevent my nomination to a chair in the University that was, or is (which is it?)."

With a few more expiring groans from Agassiz to Dr. Beck and a few more joyous chortles from the other Harvard men and a few more echoes for a year or two, the ambitious scientific program of the University of Albany collapsed, though out of the movement which had led to it and organized it and which indeed by diversion, shoaled the University itself, came a great fruitage; the Dudley Observatory¹¹ and the Albany Law School.¹² And

¹¹ The "Dudley Observatory of the City of Albany," made secure by the endowments of Mrs Blandina Dudley and the gifts of Thomas W. Olcott, was separately incorporated in April, 1852, after it had become evident that the rest of the scientific department of the University had broken down. For a while, during the directorship of Benjamin Apthorpe Gould, it navigated pretty squally seas but came out into safe waters when Professor Mitchell took the helm, just before the Civil War. Under the later guidance of Lewis Boss and Benjamin Boss, his son, it has acquired enduring distinction for the recondite and meritorious researches which it has fostered.

¹² The title "University of Albany" was transferred to the Law

in spite of the breakdown of these 1852 "Courses in Science," and with encouragement drawn from the success of the other departments the comparatively modest claims of the University of Albany grew into a dangerously ambitious program for a "National University;" and on a stormy night in 1853, Governor Seward presided over a public meeting of the "friends" of this project wherein Dr. Sears of Boston spoke at length and Dr. Beck and Secretary of State Randall applauded; and at the close of this meeting the "National University" adjourned *sine die*.

I have been thus particular about the history of this educational movement for the distinct purpose of making clear the fact that it arose and its results ensued from two clearly evident factors; the interest, general and local, aroused by the Natural History Survey, and the personal activities of Professor Hall, with their reaction upon the intellectual leaders of his community.

As to the Polytechnic School of New York, devised as a counterblast to the Albany University — its light, too, flickered out and left nothing behind by which to connect it with any living activity.

Department and retained as the holding title till 1873 when all the agencies here mentioned, with the addition of Union College at Schenectady, were united and chartered as *Union University*.

2

The Foster Geological Chart — Agassiz's criticism — Hall and Agassiz sued — The Agassiz trial — His strictures — Denunciation of Emmons — Attack on the Taconic System — Case nonsuited — Science in the Courts — Hall makes a Geological Chart — Its success — James D. Dana plans a text-book.

ONE day in the autumn of 1849, Professor Hall happened to be in the office of Samuel S. Randall, the deputy Superintendent of Public Instruction, and Mr. Randall directed his attention to something new and interesting in the educational way — a Geological Chart, so-called, prepared for the use of the schools and submitted to the superintendent for his endorsement. Hall looked over this colored and varnished wall chart, with its vertical columns showing the successive rock formations, their names, the fossils with their designations, the volcanic dikes spouting red ink all through, and his bristles stood erect as his eyes swept the great sheet and failed to find in the conspicuous lettering and more conspicuous coloration, a single mention of the New York Formations. This was a proof sheet of "Foster's Complete Geological Chart" prepared by a school-teacher at Greenbush, across

the river from Albany, by the name of James T. Foster. Though he lived but a mile or so away, Hall had never heard of this person — this audacious fellow. Assuming his most suave manner and gentlest voice, as he ever did when on the verge of explosion, he begged from Mr. Randall the loan of the chart that he might examine it at his leisure; and with it once securely rolled under his arm, he burst out in a torrent of denunciation and invective over the impudent document, and made his way out. At home he sat down in the midst of his wrath and wrote to Horsford of his discovery, sent him the chart and asked him to leave it with Agassiz¹ for his opinion. Professor

¹ Exactly how this transaction was carried out is told by Horsford to Hall in November, 1850.

“In connection with Agassiz last evening and Prof. Parsons, I was enabled to recall the history of the chart and it materially differs from what I wrote in reply to your letter from New York a year ago or more. I will tell you what it is and show you how I had got another meaning.

Your letter to me contained matter intended only for my eye, as well as the request that I would procure the written opinion of Agassiz, Jackson, Rogers, Silliman and Dana. In consequence I took the letter in my pocket with the chart and went around to Prof. Agassiz, but not finding him in left the chart and brought the letter home. The following morning I went around again to tell him for what I had brought the chart. On meeting him, a conversation something like this took place: ‘Have you seen the chart I brought here?’ ‘Oh, *you* brought it, did you?’ ‘This comes

Agassiz, always keenly sensitive to the dignity of science, replied with a terrific demolition of the "Chart" and told Hall that he might use the letter as he saw fit. Hall saw fit to print it in the Albany newspapers with one of his own of much the same tone. And thereupon James T. Foster brought an action for civil damages against Hall and Agassiz separately for libel in the amount of \$40,000 for the former and \$20,000 for the latter.

Meanwhile the offended and offending Foster had his chart quickly revised, took out the vague European nomenclature with its fossils and inserted the New York names together with the "Taconic System"; then at the bottom entered a submarginal notation: "Corrected by Professor Emmons and W. W. Mather, New York State

from Hall and he wants your opinion of it.' 'I am glad I did not know from whom it was received. I have written my opinion and have taken a copy to send to Silliman's Journal.' The other copy I asked for, not stopping to read it, had it copied and sent the original to you, I think, under my own envelope. I did not then give the letter to Agassiz because the sentences intended for me were not erased. On my return to my room with Agassiz's letter to you, as I could not have a personal interview with Jackson and Rogers and, that they might have authoritative requests from you, I erased the passages in your letter that were designed for me alone, enclosing it with Agassiz's letter in an envelope to Jackson and Rogers on their return home. I sent the whole thing on to Dana."



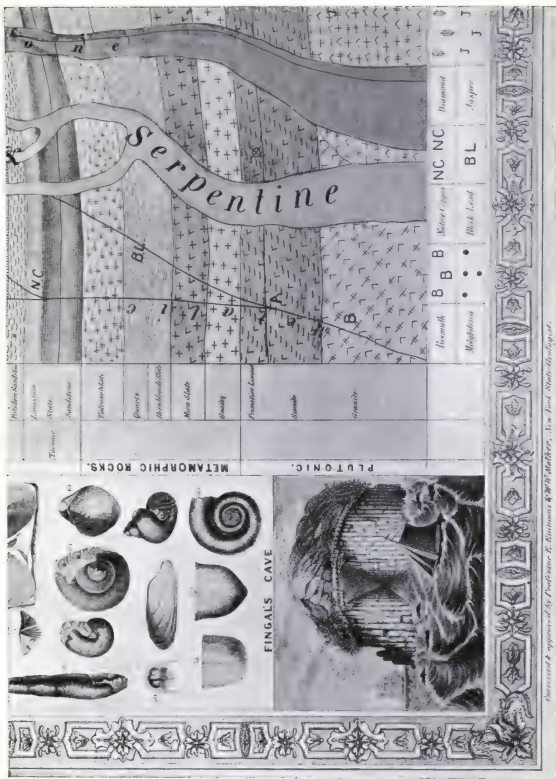
The first edition of the Foster Chart

Geologist." This revised edition was quickly copyrighted. It added fuel to the indignant fires of Hall and of Agassiz; now with the offending Taconic System broadly displayed it was indeed a chivalric adventure to break a lance upon it. And Lieutenant Mather did not help the author's standing by declaring openly in Silliman's Journal that he had nothing to do with the chart.

When the complaint in the suit was served on Agassiz, he could not understand how his stinging reproof of the charlatan and his caustic invective against an attempt to disseminate false knowledge should be construed as other than a loyal defense of his goddess, and a legitimate "critic." He writes to Hall: "The whole affair seems to me perfectly ridiculous. There can be no foundation for a suit in this matter which belongs altogether to scientific critic and has nothing to do with the case of individuals. * * * What interest have I in this matter? None but that of science. And where a State has done so much for science as the State of New York, it becomes a duty for scientific men to prevent them from being humbugged by pseudo-knowledge."

Neither Agassiz's loyalty to his ideals in science nor his intense devotion to his friend availed. The suits were pressed to early trial, Hall was charged by Agassiz to make all necessary arrangements for the defense and he entered into the business of it

with spirit and purpose. He retained the law firm of Dean and Newland — Amos Dean and John Newland — and in addition secured the assistance of Nicholas Hill, Jr.; all three highly eminent members of the Albany bar. I have heard Hall tell of nights spent in giving instruction in geology to Mr. Hill with special regard to the ins and outs of New York geology, and to the utterly nefarious character of the "Taconic System." Just how it was arranged it is hard to tell though easy to guess, but the court docket was fixed so that Agassiz's case was to be called first. It was set down for January, 1850, postponed till March and meanwhile Agassiz, untroubled, went off south to give his lectures at the Charleston Medical College. In the interval the printing of the offending chart proceeded at the old book house of Websters & Skinners in Albany and the edition was packed off to New York to be put on the market. It would appear that the shipment was made by the Hudson river night boat, and that Hall, hearing of it, took passage by the same boat. The charts never reached New York. George H. Cook, the distinguished State Geologist of New Jersey, in those days intimate with scientific affairs in Albany, told me the story of this little moonlight excursion, from which the only logical deduction was that Hall threw the entire edition of the Foster Chart



Corner of the revised Foster Chart, with marginal imprint

Revised & approved by Professor H. B. Swann, U.S. Geol. Survey, New York State University.



into the Hudson.² "Do you think he really did that?" said I wonderingly to Professor Cook. "Do you think he would not?" was the answer.

Subjected to long delays, after many postponements, Professor Agassiz's case was called for trial in March, 1851. The suit had now grown to momentous proportions as the reigning sensation in the scientific community of the country and in the civic community of Albany as well. Though the issue was trivial, the defendant was a national possession, known and honored by all intellectual America, and since his marriage to Miss Cary, bone of the bone and flesh of the flesh of the *cercle bastonnais*; it was already a *cause célèbre* and many letters came to Hall from men who expressed a wish to give testimony. Justice Amasa J. Parker was the trial judge in the Supreme Court and among the witnesses subpoenaed by the defense were John W. Foster, already eminent for his services as federal geologist, Josiah D. Whitney, his colleague on the Lake Superior Survey, James D. Dana, of Yale College, Eben N. Horsford, the Rumford professor at the Lawrence Scientific School, Joseph Henry, Secretary of the Smith-

²The Foster Chart is an exceedingly rare bibliographic item. I once found a copy torn and ragged, which had been used as wrapping paper for fossils in one of Hall's boxes, but my inquiries have failed to locate any other except the copyright sheets in the Library of Congress.

sonian Institution, and Josiah Colton, the map publisher. The plaintiff's action was based upon an allegation which implied the libeling of a copyrighted but unpublished document which, it was alleged, had acquired definite value because of its endorsement by the Superintendent of Public Instruction, and its acceptance for use in the schools of New York State, provided it was countersigned by Dr. Emmons. We can imagine then that it was an interested and impressive group that were gathered beneath Justice Parker's bench that morning of March 7th, 1851, when, after hearing the testimony of the plaintiff and his chief witness, Dr. Ebenezer Emmons, and the annihilating cross-examination of Emmons by Nicholas Hill; Amos Dean (who a few years later, by Hall's influence became first Chancellor of the University of the State of Iowa) opened for the defendant. We have not thought it necessary to give at length Agassiz's letter about the Foster Chart, but in his "Answer" the defendant restates his critique which was wholly directed against the document in its original form and defiantly strengthens it; declaring the chart to be "a monstrous map and a crude production full of false and antiquated views so represented that its mere circulation would be considered abroad as a disgrace to American geologists if they were not to protest against it before it is puffed out in the newspapers and that there is no

reference whatever therein to the geology of this Continent. * * * That the aforesaid chart does not give correctly or in their natural relations the several matters and things appearing thereon, that there are grotesque combinations among the illustrations among the Tertiary beds and that the Ichthyosauri and Plesiosauri of the Lias parade among the Pachyderms of Montmartre in as ridiculous a manner as a narrative of battles between Napoleon and Alexander the Great of Macedon would appear in a text-book of Universal History were the scene transferred to China " and much more to the same purpose. The "Complaint" asserted as a basis for damages that the chart was to be accepted for the public schools " whenever a copy thereof should be brought to the office of said Randall and of the said Superintendent with a certificate of recommendation of one Prof. Ebenezer Emmons, a man of approved knowledge, learning, judgment and skill in the art and science of geology;" and the defendant " denied " " that said Ebenezer Emmons was at the aforesaid time or is a man of approved knowledge, learning, judgment or skill in the art and science of geology as is alleged in said complaint." The trial lasted several days, and the action soon resolved itself, from a defense against the charges of an ill-advised schoolmaster, to an open assault upon Emmons and his imputed heresies. Toward that

end all of Hall's night drills of Nicholas Hill had been guided and all the vigorous testimony of the expert witnesses was, in Mr. Hill's skillful hands, pointedly addressed. The plaintiff was non-suited with costs and the loss to him was a few hundred dollars, a pleasing prospect of profit and his charts (which Hall threw into the Hudson); but Dr. Emmons emerged with a battered reputation. In his embarrassment he had weakened and contradicted himself on the stand and, try as he would, he could not uphold his Taconic System against the batteries which faced him. It was a cruel position in which the Taconic System found itself, surrounded by its enemies and on trial for its life before a jury of twelve Albany Dutchmen and Irishmen most of whom could hardly have had a glimmer of the real issues at stake; a strange forum indeed for the settlement of a scientific issue. The enemies it made were enemies for life and the echoes of this trial did not even ebb away with the life of its participants.³

³Our courts are the wrong place for Science; it seldom leaves the witness stand with credit to itself or with comprehending justice from the advocates of the statutes who surround it. "Expert" scientific testimony is too seldom unbiased to be conclusive and science is progressive rather than final; court decisions are final in intention. The incongruity and often absurdity of the conjunction have frequently been illustrated in my own experience. A road contractor once sued the State for damages resulting from the refusal of his road. The State claimed he had not used the material specified in the contract, which was a Cambrian limestone.

Thus ended the Agassiz trial. The case against Hall was never called. And thus ended the Foster Chart. But the trial of the Taconic System was not over for fifty years. Gradually the blinding acrimonies of the years have blown away; in a clearer light we see the merit in the claims of the discoverer who produced the first evidence of the earliest known life on the earth.

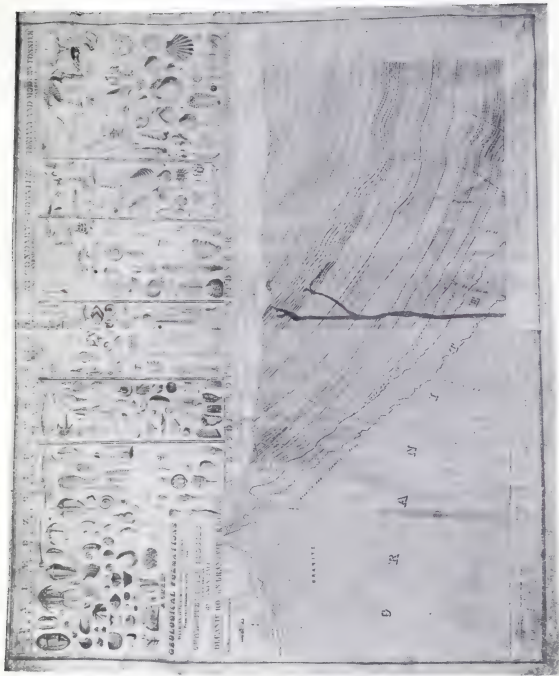
During the trial of his suit Professor Agassiz was the guest of Dr. Thomas Hun at his home on North Pearl street. When it was over Dr. Emmons called on him to express the hope that he might still have the assurance of his friendship, but Agassiz declined, sending word that his friendship would be withheld till he had some assurance of a more correct behavior; so great a hold already had Professor Agassiz upon the scientific men of America. To us, looking back on this

The contractor owned a quarry of Trenton limestone and he was suspected of using it because cheaper, though of inferior quality. A palaeontologist was called on to determine the issue and he found Trenton fossils in the road bed. The court inquired closely about this matter of the fossils. What was the difference between those of the Trenton and Cambrian? What were the relations of the rocks? Which was the older? "The Cambrian." "How much older?" asked the judge. "That would be hard to say," answered the witness with proper caution. "Would you say a million years?" asked the judge. "I think you might say that," said the witness. "The clerk will put it down one million years," ordered the court. So there is a court record in New York that the length of time from the Lower Cambrian to the age of the Trenton is one million years!

incident, it seems to carry a large element of the humorous, but it was a tragedy for Dr. Emmons.⁴ The most influential men in the science were at once alined against him; for a little while he remained in Albany engaged upon his agricultural reports; when the opportunity came he removed to North Carolina, never to return. But till his death, only a few years later, he fought for his Taconic System.

Hall's discovery of the Foster Chart set him to thinking — it was an excellent idea; he would make a chart and make it right and the authority of his name should give it currency. He did make one, even before the trial came on and sent it around to his friends for their comment. Agassiz, Gould and Silliman good-naturedly but cautiously approved, as geological charts had proved rather skittish things to endorse. To insure it he circulated a written form of endorsement among leading geologists in which he was so particular and cautious as to rate these signatures in the order of their merit, as it seemed to him. He puts Agassiz's name at the head of the list and asks Professor Hitchcock to sign in the blank space next below. Then having worked out satisfactorily with the Super-

⁴ Not a word of it appeared in the newspapers and Horsford does not hesitate to intimate the general impression that "the reporters were bribed to stay away." Whatever the reason, the fact did not help Dr. Emmons.



Hall's Geological Chart

intendent of Public Instruction (S. S. Randall) a scheme for distributing the chart through 11,000 schoolrooms in New York, he induced the same official to propose to Joseph Henry a further distribution through the Smithsonian, asking at the same time an endorsement of his chart. Professor Henry tells the chartist (September, 1851) that "the committee refuse to recommend that a certificate be given on the ground that *the object of the Institution is the promotion or increase of knowledge, not its diffusion.*"

James D. Dana, learning of the plan for the wide distribution of the Hall chart and having been incubating the preparation of a text-book on geology, writes to Hall as follows (March, 1851): "I have for some time contemplated a Geology of about the size of Lyell's new work and should I undertake it I should endeavor to make it subservient to the interests of your chart, feeling at the same time, I acknowledge, that the book would derive as much benefit by this action as it gives. I have never heard it intimated that you had such a work in contemplation [Hall's intentions in this regard were now ten years old], or any work of the kind, beyond a small volume to accompany the chart adapted for the schools of the State. Such a volume the chart could have as its attendant."

The chart was a success scientifically and commercially but Dana's Text-book was not to ride

into fame on the back of a chart. It did not appear for more than ten years later.

And so, with his feverish and unrestrained impulses, Hall was continuously involving himself in odd and often difficult situations and as his biographer I am very glad that my subject added spice and color to his record by keeping his colleagues on the *qui vive*, with or without cause.

3

Survey of the Lake Superior Mineral Lands — Charles T. Jackson — Trouble with his assistants — John W. Foster and Josiah D. Whitney in charge — Hall joins the expedition — His relations to it — Whitney's letters — Hall's important report on Parallelism of Geological Formations — D. D. and Richard Owen — Trouble with Foster — Boston matters — Agassiz and Desor — Palaeontological Troubles — Hall's acquisitiveness — Developing his estate — Death of Andrew J. Downing — The red brick "Office" — Emmons as an agriculturist.

IN 1847 the Federal Government undertook, on behalf of the General Land Office, a survey of the Northern Peninsula of Michigan, with the purpose of ascertaining the quality of the lands in this new State and establishing a classification of them. Doctor Charles T. Jackson was placed in charge of this survey of these Lake Superior mineral lands. We have referred to Doctor Jackson as a man of great attainments and versatile genius. He had already executed geological surveys of Rhode Island, New Hampshire and Maine, but prior to this, as a young doctor of medicine, he had rendered a great service in the hospitals at Vienna during a devastating outbreak of cholera; he had aided S. F. B. Morse in the construction of his telegraph registering devices, and his claim to

have devised and put in practice the application of ether in anesthetization before either Dr. Morton's or Dr. Wells's experimentation, is a matter of record and this claim was recognized by the French Academy with distinguished honor.¹

Jackson had already made acquaintance with the new copper country of the Great Lakes and for this survey he associated with himself several men of excellent experience; John Locke of Cincinnati and Wolcott Gibbs of Harvard; John W. Foster of Ohio and Josiah D. Whitney of Northampton. In spite of, and perhaps because of his versatility, Jackson's personality was unpleasing. He lacked adaptability and consideration of others' opinions and in this Government undertaking he was soon at loggerheads with his superiors at Washington, with his assistants and with practically every private mining interest which had ventured into the Lake Superior country.

"Alas these squabbles," writes Gould to Hall (May 1849). "Shall we ever emerge from them? On Saturday evening

¹ Occasion may here be taken to correct statements which have been printed regarding Jackson's alleged connection with the New York Survey. Dr. Merrill says he was "appointed one of the State Geologists of New York but declined" (p. 702); and Dr. J. B. Woodworth states, in his biographical sketch, that Jackson was called on in 1839 to draw a plan for the New York Survey, a statement repeated in Appleton's *Cyclopedia of American Biography*. I have never seen documentary evidence that Jackson at any time had any official relations with the New York work or with the New York men.

[at a meeting of the Boston Society] Foster and Whitney made their appearance stating that in consequence of information received from Washington giving them warning that as the Western men were about taking means to have Dr. Jackson removed for inefficiency, idleness, disagreeableness and other obnoxious reasons and that they [F. and W.] were to be involved as aiders and abettors of his misconduct, they had resolved that a separation must take place, that they would resign and show him the reasons. That the only terms on which they could continue on the Survey would be that Jackson himself should resign in their favor."

Jackson did resign, and Foster and Whitney were placed in charge of the survey. Meanwhile, in 1848, Agassiz, with Edouard Desor his secretary, Jules Marcou, who had just arrived from France, and a small party of Cambridge students, made a trip into the Lake Superior country. Agassiz was looking for fishes and glacial scratches, Desor was better competent in drift phenomena and geological structures, while Marcou² went along for what he could see and get.

² "My friend Mr. Marcou," writes De Verneuil by way of introduction to Hall (Paris, March 26, 1848), "is sent by our National Museum to explore the rocky mountains. He is a good geologist and a very kind young man." "Marcou came to this country," said Hall (my notes of his conversation, November, 1895) "as a representative of the Geological Society of France commissioned to make for them collections of American fossils. He came to me and I entertained him at my home and sent him into the Helderbergs but he was too lazy to get fossils; he was very tall and it hurt him to stoop over." Marcou's later relations with Hall became greatly strained over the Taconic controversy.

Hall had already been into this country in a private capacity and he was familiar with the labors and the field operations of David Dale Owen and Colonel Charles Whittlesey. His definite engagement with Foster and Whitney seems to have been the result of a letter written by Whitney to Hall in which the young enthusiast dares to tell the New York protagonist that the Lake Superior rocks will not fit into his System of Formations. Hall tells Whitney (May, 1849) very plainly that Lake Superior is not the place to settle questions of geological nomenclature:

"In response to your views on the subject of geological nomenclature, I do not agree with you in feeling so much inconvenience in the multitude of names which have grown out of the results of investigations in different and distant localities, but admitting them to exist, *the Lake Superior Region is not the place to settle that question.* Unless you have a great mass of new facts you will not succeed in changing any name now applied and I tell you candidly and with the best will toward your labors that your labor will be lost."

It became evident at once to Foster and Whitney that Hall as a collaborator would be safer for them and their work than Hall as a reviewer, and the following year he was enlisted by them in their undertaking. Desor, who was a pretty good geologist and was now following with personal acquaintance the proceedings in the Lake Superior District writes (Cambridge, Feb. 13, 1850):

"It seems to me that the very extensive range of the Trenton should be dwelt upon more than it is commonly done, and if you were not a palaeontologist or rather *the* palaeontologist *κατ' ἐξοχήν*, I would beg leave to parallelise these infra-Trenton groups with the Cambrian of Sedgwick."

With such repugnant sentiments as these abroad, we can readily believe that Hall felt it his duty, when the proposition came to him, to enter this Lake Superior field and help put these men right. So in 1850 he joined this undertaking, as did also Desor, who was to study the Drift problems. Colonel Whittlesey was also a member of the survey, giving his attention to problems of topography and terrestrial magnetism.³

Mr. Hall did not get started till late in August and he carried in his pocket a note from Desor to Leo Lesquereux then at Columbus, Ohio, written from Washington Harbor, Pottawotomoy Island (Isle Royale), which was by way of introduction to another of the small army of Swiss emigrés then pursuing American science.⁴

³ Charles Whittlesey, graduate of West Point and colonel in the U. S. Army during the Civil War, rendered service of a high order in the exploration of the Upper Great Lakes and Mississippi country. He was connected with every official expedition engaged in opening this rich mining country, and in any competent history of American geology his work must be accorded important place. (See his memorial by Alexander Winchell in *American Geologist*, September, 1889).

⁴ Lesquereux, an accomplished botanist, was one of the Neufchâtelais who followed Agassiz and Guyot to this country. After

"These lines have no other purpose than to make you acquainted with Mr. James Hall, the celebrated New York palaeontologist and this year one of the members of our expedition. Be kind enough to take him to the quarries at Columbus, where we were together. If perchance you or your sons have collected some fossils for me, kindly turn them over to Mr. Hall. That is the best use you can make of them, for he is a much better judge than I am."

After leaving Columbus Hall went to Green Bay where he joined Colonel Whittlesey, canoed up the Fox River to Lake Winnebago and on to Fond du Lac. The next year he got further north along the lake shore, returning by way of Milwaukee. In the winter between, the members of the survey were engaged in outlining their reports and the following letter from Foster is of interest in intimating how his work was to be divided:

BRIMFIELD, CONN., 1st Dec., 1850.

MY DEAR MR. HALL:—

I expect to go to Washington about the 13th of this month. I shall propose to Whitney to meet in Albany, if agreeable to you, during the latter part of next week, in order to consult with regard to the nomenclature, etc. of the rocks. You had better take occasion to go to Boston, therefore, this week. Whitney and I will describe the geology of the

a brief stay in Boston he went to Columbus where he became associated with William S. Sullivant in his work upon American mosses. His subsequent career, in which he attained great excellence, was devoted to the study of fossil plants.

Azoic System and of the Potsdam Sandstone as developed on Lake Superior, as we are more familiar with its distribution and mineral character than you. I wish you to describe its westerly prolongation, and also the range and extent of the other groups of the Silurian, unless it would relieve you of much labor for us to collate your notes. We do not wish you to address a formal report to us, but to take up the description of the rocks where we leave it. We shall state that the chapters on the Silurian were composed by Mr. Hall, those on the Drift by Mr. Desor, that on magnetism by Mr. Whittlesey, etc. In this respect the report will be a unity. I have written about a hundred pages, which I wish you to read and criticise freely. It is better for us to discuss these questions before the publication of the Report than after. Two years ago you thought me a little wild, but I trust that you are now satisfied that I was not far from right. I think that our district contains some new facts in geology and if we bring them out properly we can not fail of acquiring some credit.

I was disposed to consult with Owen and adopt a common system of classification for the rocks of both districts, and in fact we were instructed by the Committee to do it, but Owen has treated me so rudely that I shall make no farther advances. He is welcome to all the glory in describing the New Red Sandstone of Lake Superior and the Silurian groups 800 feet below the Potsdam. You did not write whether you saw him.

As the New York Survey is the only one in which the matured results have been communicated to the world, it seems to me no more than justice that the nomenclature applied to the different groups in that state should be adopted so far as they can be recognized in other states. Your work on Palaeontology must form the standard of reference for the whole country.

I have received Whittlesey's notes on the Topography of the Silurian groups which I will pass over to you when we meet.

Yours truly,

J. W. FOSTER.

JAMES HALL, ESQ.,
Albany.

In the early months of 1851 the attention of both Hall and Whitney was engrossed with other matters — the *foster* (as Whitney wrote the name distinctively) suits and the Albany University for one, a trip to Europe for the other; but Hall went west as soon as the Agassiz trial was over and got back before Whitney left the country, and so Whitney writes to him, in his usual whimsical vein:

“The What d’ye call-ems of the Pitchered Rocks — have you satisfied yourself what they are? I mean the *Fucoides duplex* (or the *Fucoides* do perplex) of the Grand Portal. I have not heard from you in so long that for aught I know you may have rolled yourself up in a ball and got petrified.”

There is a thread of joyous nonsense that runs all through the correspondence of these young fellows though it was principally the outburst of Whitney's unrestrained enthusiasm. In the early winter of 1851, Foster and Whitney met in Philadelphia for the purpose of writing their reports and there they are joined by Desor and Dana. Amid their reports they are dreaming dreams and scheming schemes. Desor and Whitney agree

that they will write a joint Text-book on Geology, to which Dana demurs, having already in mind one of his own. Then with Henry Rogers for an advisor, they are going to organize a Geological Society and "Rogers will second anything that may be done with all his might and main. We have thought of having a permanent location in some city where a library and collection might be gradually gathered together, and where eventually a Journal devoted to the Science of Geology in the widest sense of the term might be edited."

There they sit together "over a cheery wood fire," "trying to knock your manuscript into proper shape for the printer," and Whitney in despair declares to Hall, "I wish to heaven you would put yourself into the postoffice or mount the telegraph wires and come on." Into these solemn sessions Joseph LeConte occasionally strolls and he gives them "the honor of dining with us today. During the dinner, on the strength of a bottle of claret, I believe that he and Foster cooked up a plan of exploring the valley of the Missouri under the patronage of the Smithsonian Institution." Hall writes that he had agreed with the Governor to complete his Palaeontology in two years and that he is busy; whereat Whitney jocularly remarks that the suggestion is "a good one. Allow me to invite you to a small oyster supper to be given when the last volume makes its appearance!"

These sessions broke up before the beginning of the year; first Foster "absquatulated, having gone home for a turkey-shoot;" then Desor, who had now fallen from Agassiz's good graces, was planning to go back to Switzerland, while Hall was much occupied with his University of Albany, where the lectures were already beginning. Soon, as it turned out, Hall in the midst of all these things, his impending trial (which, however, never came off), his University, his Palaeontology, had produced for this report not alone an account of the fossils of the lower rocks but a very important thesis on the Parallelism of the American Palaeozoic Formations with those of Europe, the most comprehensive presentation of this subject that had yet been made and one of lasting value, for it instituted a grouping of the formational units which still demands recognition.⁵ It outlined the classification given by Dana at the Providence meeting of the American Association in 1855, and which has been perpetuated in influential editions of Dana's Manual.

There had arisen among the geologists of this Lake Superior expedition a singular antipathy to the work and conclusions of David Dale Owen in the upper Mississippi Valley. It is a feeling that breaks out repeatedly though it was never shown

⁵ Parallelism of the Palaeozoic Deposits of Europe and America 1851.

by Hall, whose fidelity to his old friend of New Harmony days was never shaken. The trouble seems to have arisen over doubts and debatable claims as to the age of the fossils in the low sandstones of St. Croix Falls, Wis. Desor, in 1849, had brought in and exhibited to the Boston Society, fossils which were regarded as far below the Potsdam sandstone at St. Croix and some time later Richard Owen had given this debated matter a comical turn by expressing the opinion that certain fragmentary trilobites from the same rocks were "vertebrates." This tickled Whitney who had now gone back to Boston and when these views were reviewed before the Society he writes mischievously to Hall (May, 1852):

"Have you heard that [Richard] Owen has eaten up his vertebrates of the Potsdam and that after digesting they have come out crustaceans? I will bring you his remarks. They are rich. Desor was present at the meeting. Agassiz is here and intends to remain here during the summer. He was, as you might imagine, highly tickled at the Oweniana. The other Owen, the 'D — D' one, has been doing something extraordinary in the chemical way, viz, attempting a new earth. Let us hope that he will give us next a new heaven!"

The honorable and important part taken by Hall was appreciated by the responsible heads of the undertaking, and Whitney's letters are written on stationery carrying an embossed device at the top

— three linked rings, the two at the side enclosing the initials *F* and *W*, that in the middle an *H*. But notwithstanding this pretty symbol of *F* and *W* standing locked-armed with *H*, the inevitable rupture followed and by 1852 Hall is writing to Professor Henry a most violent series of charges against Foster for pirating and selling his geological map of the United States which he had been engaged on since 1843 and had displayed on various occasions. He makes out a serious case, for there is a letter in the files by Foster himself, telling with some glee how he made a copy of the map and sold it to the Land Office for a considerable sum and was proposing to make one for the Smithsonian at Professor Henry's request. It was the same map, now improved with time, that had made the trouble between Hall and Lyell ten years before; the same confiding disposition and the same furious resentfulness when he believed himself imposed upon. So when Governor Grimes, a few years later, asks for his opinion of Foster, saying that he has been recommended to him for State Geologist of Iowa, Hall writes:

“It would not be proper for me to reply to this question. A reference to Professor Agassiz of Cambridge or Professors Bache and Henry at Washington would elicit reliable information. The Governor could also inquire of Professor Swallow or Doctor Litton of the Missouri Survey. I might mention that Mr. Foster is at present one of the Executive Council of Governor Gardner of Massachusetts

and it may be that his prospects of political preferment would interfere with his acceptance of the position in Iowa."

Hall's touch with the affairs of the Boston circle was kept intimate all during this period. He had been the principal agent in securing the appointment of Horsford to his professorship and Horsford's earliest relations at Cambridge were with Dr. Webster, at whose house for a while he made his headquarters. The tragic end of Dr. Webster cast a pall over the entire circle and the Boston letters of this period were filled with gloom. Horsford was perambulating Boston trying to borrow money on Hall's collection; first from Amos Lawrence, Jr., but his money had all been tied up in the "Wisconsin College at Appleton;" in his sympathy for a great scientist in trouble Mr. Lawrence went over to interview William Appleton, Nathan Appleton and John A. Howe. No money came and Horsford suggests that Hall take out an insurance on the life of his wife and use that as security, and also casually advised him "to take a light breakfast and a walk of two hours toward the close of the day."

Agassiz has "cleared his house of all the loafers, stays at home almost all the time, has hired a phonographer and is going ahead on his own hook, no thanks to Desor, Gould or anybody else. He is now engaged on the 'Unity of Races' question"

(Gould's letters). Desor was in trouble, for Agassiz had severed relations with him. Desor had even gone to the length of making deliberate charges against Agassiz in the presence of Mr. Lowell, Mr. Storer and T. B. Curtiss, governors of the Lawrence School and Gould says (January, 1849) that though Desor is giving lectures "in geology to about 25 persons, I do not attend them, being no longer on good terms with him." The situation troubled Agassiz: "I have felt so unhappy about various occurrences during the last year that I have led a very secluded life to myself and the studies of my choice. Now I have my boy with me and I feel brighter and my friends must experience it" (June, 1849).

After his work on the Foster and Whitney Survey was over, Desor decided to return to Europe. The loss of Agassiz's friendship in those years was an irreparable damage and he had unwisely precipitated himself into an action at law against Lieutenant Davis, a member of the American Academy of Arts and Sciences in Boston, alleging slander; an act which led Benjamin Peirce to move Desor's expulsion from the Academy, although Desor was sustained in his action by the court. Desor is frequent in his letters to Hall, many of them charmingly written and full of clear-headed suggestions regarding geological matters,

but he closed his correspondence in February, 1852, on the eve of his departure, with the words: "Bitter as my experiences have been in this country, I will treasure the more the recollection of those whom I can respect and I hope that you will dispose of me in all circumstances whenever and wherever I can be of any use to you."

During these years Hall seems to have developed at times a sort of pantophobia over his Palaeontology. His engravers troubled him tremendously. They had contracts with the Governor on which they could not realize unless Hall furnished them with "copy," and he declared that neither Science nor he should be forced into undue haste. So the engravers complain and Hall breaks out into lamentations. To him Gould sends sympathetic condolence (July, 1849):

"A scientific book can not be written like a sermon or a book of travels. Ask any of your politicians how much longer it would take him to write a quarto volume of Fourth of July Toasts, which he expected would be clapped for their pith and brevity, or a volume of congressional speeches or newspaper leaders, and he will have some idea of the difference between them and your Geology. Surely it would be a just cause for the scientific world and all the lovers of enlightened legislation the world over to denounce the Empire State if they should throw obstacles in the way of a work of so much importance, so anxiously anticipated, so satisfactorily executed thus far, and so far advanced toward completion."

As soon as some legislator makes an inquiry about expenditures or asks to be informed, or a committee is advised to look into the work of this extraordinary official standing out alone without obligation to any bureau or department of State nearer than the Governor's office, Hall is sure to make a ramp among his friends with mingled bathos and denunciation; to their mixed delight, distress and disgust. Such recurrent situations were innocent enough in themselves and brought upon him some advice from Randall, his friend of Cortlandville, soon to be Secretary of State:

"I have not the most remote idea that the work will be suspended and believing that the Geologists will be found clean handed of all connivance with peculators, if any peculators there have been, I regard their triumphant vindication from all such charges, open or covert, as certain. And crazy must that man be who would propose to hold them responsible for the acts of our Governors and Legislative Committees! For God's sake, Hall, discharge this irritating subject from your mind, save your strength for yourself, your family and science, and do not wear it away by suffering yourself to be annoyed and fretted by circumstances which you will laugh at when they have passed by."

The collector of whatever it may be, is or should be a connoisseur, whether of science, art or buttons. The great collectors of the world have been the founders of the great museums of the world and no man can be a great collector unless head and purse are dominated by an all absorbing and exclusive

zeal touching close on madness. If the collector's temperament is not from on High it is at least Walpolian. To the vision of the collector there can be naught else than misdirection in the distribution of his *objets* when he sees them in another's possession. Professor Hall enjoyed through a long life a reputation, honestly enough come by, for extraordinary tenacity of another's materials, borrowed by him as imperatively essential to his scientific investigations. My long acquaintance with him acquits him fully of any deliberate intention to withhold. He borrowed and it may be he hoped the owner might be generously moved or might forget, and there was always a chance that eternal nepenthe would take his part. He himself could appreciate these objects best of all; why should they be scattered over the earth out of their proper association and remote from their usefulness? He did return borrowed specimens, but unquestionably with many a wrench of heart as he saw them pass out of their predestined association. This extraordinary tenacity and absorptive disposition filled him as full as St. Anthony with the arrows of his critics, and sometimes these shafts were sharp and poisoned; yet I liken him to St. Anthony for he was blameless of evil. He did indeed keep certain beautiful crinoids, brought together by Dr. Troost of Tennessee, and which he had on loan from the Smithsonian Institution from 1852 until his death

— a matter of 46 years, but that was rather an exceptional case.⁶

I cite a single characteristic letter illustrative of this constructive trait, one which his correspondence would many times duplicate.

GREATFIELD, near AURORA, N. Y.

9 mo. 1852.

JAMES HALL:—

Some time ago I wrote to Professor Horsford of Harvard University to inquire what had become of the fossil which belonged to Amos R. Willets and which was borrowed of him in the Summer of 1838. His answer was that the shell had been put in thy hands to give thee opportunity to draw and describe it, hoping that it might be spared a little longer for that purpose. Now the owner is anxious to obtain it and if thou would send it to me or put it in Luther Tucker's hands I should be greatly obliged as it was through a letter from me that Professor Horsford obtained it.

Thy friend,

DAVID THOMAS

⁶Which had better be set right now because of the publicity given to it after his death. Hall and Agassiz entered into an agreement with Professor Henry to prepare and illustrate a monograph of these crinoids for publication by the Smithsonian Institution. The agreement called for the acquisition by loan of similar outstanding materials in private collections, for the preparation of necessary drawings and for compensation to the authors. The drawings were made by Mr. Meek, Hall's assistant, and paid for by Hall. It does not appear that Agassiz ever took any part in the work, but the descriptive matter was in part, at least, prepared. Just what happened at this point is not evident except that the Smithsonian made no reimbursements for drawing or labor and Professor Hall held all of the material, as he thought himself justified in doing, until the Smithsonian should adjust the matter; which it never did.

Once, when under an imputation of this kind from one whom he had substantially befriended, he wrote (to W. H. Barris):

"It is quite sure that I can not always do all the work that I lay out for myself and consequently can not finish with a set of fossils always at the time I may appoint. However, I can not change mankind or control men's tongues. I am necessarily shut up and hard at work and can not go about to gossip with my neighbors nor have I an opportunity of defending myself from the ill-natured remarks of those who profess to be my friends, or those who are my enemies. I suppose my destiny is to work on in the same way to the end."

Amidst all the various activities of these years Mr. Hall was busied in developing his new Beaverkill property on the outskirts of the city. He was still setting out ornamental and fruit trees and in planning his new estate he had engaged the aid of Downing and Vaux of New York; Andrew J. Downing and Calvert Vaux, the most distinguished of American rural artists. Downing and Vaux had laid out the parking of the Capitol and the Smithsonian at Washington, and after the death of Mr. Downing, Mr. Vaux planned and developed many important public works; the Central Park enlargement, Prospect Park, Riverside and Morningside Parks and the Niagara Falls Reservation. While engaged for Mr. Hall, Mr. Downing was drowned in 1852, in the burning of the Hudson River steamer "Henry Clay," on which he was a

passenger. Of this event Mr. Hall is informed by Mr. Vaux and in replying writes from the steamboat "Statesman" on the Ohio river:

"It is not saying too much that Mr. Downing was doing more to cultivate and elevate the tastes of our people than all others and therefore, if we regard advancement in civilization and refinement as our highest aim, he was greatly aiding in its accomplishment. The memory of Mr. Downing will live in the hearts of his countrymen who will not cease to deplore his untimely death."

On this estate Hall had built a red brick retreat in which he assembled all the personnel and paraphernalia of his work. It was a spreading one story structure with one large room and galleries for his collections assembled in some thousands of drawers, with a study framed in books. Not long after, he removed his family to a dwelling on the place and some twenty-five years later built another more elaborate house nearer to his brick "office," but during many years this red office was his real home. Here he worked and slept and here his associates labored from the time of the arrival of Mr. Meek, the first of this long retinue. Mr. Hall's property is now a part of a public park, first appropriately named Beaver Park, from the Beaverkill which had cut a gorge through its upper reaches, but now rechristened Lincoln Park by a patriotic but unimaginative Common Council. The dwellings are gone but the brick office remains; and under a



The "Office," on the Beaverkill; still standing in Lincoln Park

promise from the city that it shall continue to stay, it has been marked by a tablet carrying this inscription:

This Building was Erected by

JAMES HALL

State Geologist of New York

1836-1898

For nearly fifty years it served as his office and laboratory and from it graduated many geologists of merit and distinction. During most of that period it was an influential and active centre of geological science in this country.

Placed by

The Association of

American State Geologists

1916

Doctor Emmons, we have noticed, was now navigating pretty stormy seas, but his craft was a picturesque one, to say the least. To the Albany community he stood as professor of obstetrics and geologist — a weird combination, indeed. To the State service he was an agriculturist and though this field of work at first opened for him the door to a full exposition of his Taconic System, it soon impelled him to write about apples, potatoes and gooseberries and finally, to compass those agricultural agencies, the insects. Dana's letters after the

Foster trial did not fail to make fun of the "Pomologist," and it is pretty evident that his work on the insects of New York gave little satisfaction. The versatile Haldeman had wanted to do this work and he tells Hall in May, 1849, writing from Columbia, Pa.:

"I was called upon a few weeks ago by two gentlemen of your State in a semi-official way on the subject of the New York Survey, particularly the unfinished portions or the Insects. I was informed that if anything definite should be done they considered it probable that I should be the person called upon to do the work."

Soon afterwards he told John L. LeConte of this interview, whereupon the latter felt that he ought to have at least a share in the work. But Emmons went on with it. Doctor Haldeman's fortunes had gone amiss and, later in the year, he asked Hall for the curatorship of the State Cabinet and then for a professorship in the University of Albany; but there seemed no opportunity at Albany for the use of his effective talents.

CHAPTER VIII

THE PALAEONTOLOGY OF NEW YORK

THE PERIOD OF VOLUME III—1853-1860

1

Influences of Hall's researches — Search for an assistant — Colonel Jewett — Fielding B. Meek — Ferdinand V. Hayden — Expedition to the Mauvaises Terres; its difficulties and results — Relations with Meek — Agassiz's Letters — Berkshire Boulder Train — Lyell and the Crystal Palace Exhibition — Joseph Henry's Albany discoveries; correspondence over — Land and Mining projects — Collapse of the Cambridge plans — The Bible and Geology; Tayler Lewis and J. D. Dana — Troubles at Albany — Letters of Lincklaen and Leavenworth — Passage of appropriations.

THE second volume of the Palaeontology was now done. The panorama of the life of the Silurian System of New York was complete and, for its author, the covers of the ponderous book were practically closed. Now that the burden was lifted and he was free for a while from the troubles of interminable proof reading and the worries of plate printing, Hall determined to take his share in all the issues of American geology in so far as he might justly claim to be competent. We have had occasion to notice his concern at this

time with the origination of the University of Albany; the fact also that out of this movement rose the Dudley Observatory; and it may be added that in all the dark days of the early career of that institution when the feeble craft was driving without anchor and the screeching of the storm winds filled all the scientific atmosphere of the country with stupefaction and unnumbered printed pages with the spume of battle, Hall was aboard ship, helping or hindering as best he knew how.

He was conscious of his recognized supremacy in his science, but he used his commanding place only to advance, or it might be truly said to control its course. His new volume had still to find its effect, but its predecessor had reared a crop of students in every part of the country where the rocks of the "Lower Formations" were found with their fossils. New York, the parent state, had a parent's generous return in students and collectors, and in the great Middlewest, the Palaeozoic harvest field of the Ohio and Mississippi valleys, Palaeontology I was the only competent key to the rocks and a key with the help of which amateurs became professionals and collectors became State geologists. One after another, the states in this "Valley of Democracy" called upon those who understood their fossils to organize their geological surveys and in those days Iowa, Wisconsin and Missouri, Kentucky, Illinois

and Ohio, owed in very large measure their official surveys to the impulses drawn from the Palaeontology. How much more might be said of a wider influence of this sort need not here be sought out, but it still stands to the credit of those states and years that the activities of pure science led the way and have longest endured. Now, by consequence and contrast, all have become officially "efficient."

Up to the time of the completion of his Volume II, Hall had done all the work himself. There was no one competent to help him in his descriptive work even could he have afforded to pay, but now with increasing outside interests he required such an assistant in the accumulating and handling of his collections. Among the many collectors he had created or, if not that, had sought out and encouraged, none was more enthusiastic than Colonel Ezekiel Jewett, an unusual character worthy of our especial notice.

Colonel Jewett had earned his commission under General Winfield Scott at Chapultepec and the warrior was no longer young when he turned his attention to the study of fossils. At home in the fruitful localities of central and western New York, these "medals of creation" seem to have exerted a fascination upon him which inveigled the tough old soldier into every form of exposure and into every sacrifice of comfort. Invincible in his

search and accordingly successful; intelligent, quick of apprehension and understanding; exquisitely and effectively profane, the "Colonel" became as noted a figure among the amateur geologists of his time as he was successful collector. In later years his enthusiasm, with which he infected many good and influential citizens of New York, brought to him the curatorship of the State Cabinet of Natural History. Throughout these years he unfailingly acknowledged his indebtedness to Hall and even while he often condemned him most effectively to his face, he would let no other man do as much.¹

Hall had also inspired David Christy of Oxford, Ohio, an agent of the Liberian Colonization Society, who traveled much in assembling his negroes in order to send them out, to what, in his

¹ No distinguished geological visitor came to New York without seeking the "Colonel" and his collections. He had collected in many States and his friends included Lyell, Agassiz and Desor, Dana, Hitchcock, Whitney, Rogers, Hayden and Swallow; but his influence went farther in the case of Hall, for his intimacy with Ledyard Lincklaen brought salvation when a few years later there seemed no place in Hall's firmament for the sun to break through. A few extracts from Jewett's letters of this time are given as illustrations of his struggles and his spirit.

(Jan. 29, 1853) "No one asks for fossils and I don't believe they ever will while I have any and the only available use I can think of making of them is to cook them into a chowder. Very few might like to attend such a clambake. Let me see who I could ask to the entertainment? There is yourself and Agassiz, Randall and Lincklaen—no, Lincklaen is getting tired; Gebhard—no, he would sell his share for a

letters, he calls "Ohio in Africa"; and he finds fossils as well as negroes all along his pathways. John A. Warder of Cincinnati, A. H. Worthen of Warsaw, Ill., Sidney S. Lyon of Jeffersonville, Ind., are assembling materials for him, and an old Rensselaer School student, George Scarboro, writes from Owensboro, Ky., to recommend for employment a young geologist of some experience by the name of Fielding B. Meek.

Mr. Meek had lately returned from Owen's Survey of Iowa, Minnesota and Wisconsin, and his acquaintance with the old rocks of the upper Mississippi and his skill with his pencil seemed to be just the qualifications Hall was seeking in an assistant. Mr. Meek was not physically strong and all his life suffered from this handicap, but he proved to be a man of exceptional skill in

drink; Dana—he would pick out the corals, and Emmons would not join if the Taconic were left out."

(1853) "Let me tell you *subrosa* the promises of scientific men as far as I know them are *d—d bad investments*. There are more fossils due me than would shingle a good sized church and I would not put up a box for the Angel Gabriel without he pawned his trumpet for pay."

An amusing thrust at Dr. Emmons (1855):

"How do you stand with the Power behind the Throne [Thurlow Weed]? Can't you manage to have *Fossils Injurious to Vegetation*? Then there would be no trouble to get an appropriation.

P. S.—Did you ever have the ague? I have not been so ashamed since I rolled a watermelon patch—an old soldier of twenty battles and sixty years to shake!!"

observation and delineation and his love of the work into which he was inducted by Professor Hall's help and cooperation, brought to him high repute in his profession. Meek came on to Albany in 1852 and was soon engaged, under signed agreement to remain, on the drawings of fossils which were being prepared for the next volume of the *Palaeontology*.

When Hall was returning from his Lake Superior field work in 1851, he stopped at Cleveland to call on his young friend John Newberry and there was introduced to an energetic youth who had been making some geological studies in the neighborhood and who wanted to enter on a career in natural science by way of the medical school, as many of the men of that time chose to do. This youth was Ferdinand V. Hayden, in later years to become director of the United States Geological Survey. Hall proposed to Hayden that he enter the Albany Medical College, holding out to him the promise of geological service when his course was over. It was too tempting a proposition to resist and the young man came on, entered the school and lived at Hall's house, meanwhile tramping the classic grounds of the Helderbergs and Schoharie. As Mr. Meek was then in Albany, it was at Professor Hall's table that these two men came into a first contact which led to a long standing scientific partnership. Just about this time,

1852, Doctor John Evans, who had gone under Government auspices on an exploring expedition up the Missouri river, returned with a store of fossil treasures from the Mauvaises Terres of the White river region, then in Nebraska Territory, bringing unheard of vertebrate remains and extraordinary invertebrates. Professor Hall was at once on the qui vive over this new-found storehouse, almost the first hint of the vast buried treasure of the great West. We may imagine the fever of interest these discoveries excited around the family table at the old house on the corner of Morton street and Delaware avenue, and may well believe that Hall yielded not unwillingly to the pleadings of these young men to send them out to that country—a country farther away from Albany than the heart of Tibet is today; a journey by uncertain boats up the Missouri among still untamed tribes of Red Skins. But the booty was irresistible and after some correspondence with Dr. Leidy² about the chance of being reimbursed

² Philadelphia, April 20, 1853

"I am glad to hear you are going to send Mr. Hayden to the Mauvaises Terres which, with its remains, I view as a darling child. The information of two German collectors going there this summer has annoyed me exceedingly and I am delighted to hear you possess the same patriotic feelings as myself. * * * I think I could raise a few hundred dollars at the Academy toward sending another person and if you write to Prof. Henry I think the Smithsonian might contribute some aid."

JOSEPH LEIDY.

for any vertebrate fossils obtained, Hall finally agreed to finance Hayden, though he did not feel that he could release Mr. Meek from the contract under which his work was being carried on. Hayden's boyish enthusiasm is full of ambitions and hopes. With the opening of spring he starts for Cleveland where Doctor Newberry helps him with his preparations, and from there he writes of his intention to stay all winter in the Bad Lands. Mr. Meek, left behind in Albany, teased to be permitted to go along and though Hall realized the condition of Meek's health and needed his assistance in his New York work, yet he gave way, and so the two young men bring up in St. Louis, commended to the consideration of Pierre Choteau & Co., the Hudson Bay Fur Company's agents, and to Doctor George Engelmann. Then their troubles began. Doctor Evans was also in St. Louis, outfitting for another expedition into the country for a Pacific Railroad Survey into the Northwest, cooperating with Governor Stevens of Missouri and the geologist, Benjamin F. Shumard. The young men found they were not welcome companions to this party on the only boat that was going up the river that season. The Government party wanted no competition and Governor Stevens was quite forbidding in his attitude toward the new comers. Doctor Engelmann, high-minded and large-hearted, espoused their cause

and by lucky chance Agassiz happened just then to be in St. Louis lecturing to the Academy of Science and by his great influence helped to satisfy the Evans party that there were fossils enough for all. Hall himself, with characteristic procrastination when payment of money was involved, nearly wrecked his own plans by failing to send on a remittance for expenses. Doctor Engelmann³ writes:

ST. LOUIS, *May 23, 1853.*

“Your young men have at last left here, but you will have heard that from them several days before this reaches you, and our friend Agassiz has no doubt explained to you everything which remained doubtful. Mr. Hayden, as you know, felt at a loss to account for your long silence. Then came Governor Stevens and Doctor Evans and his expedition and their antagonism to your plans. Your friends applied very earnestly for advice to Agassiz and to me. Both of us thought that the wisest plan would be to give up the expedition if you had your expenses refunded and if both young men were suitably and honorably provided for in the Government expedition. After long diplomacy conducted by Agassiz principally, this was agreed to by Doctor Evans but finally rejected by Governor Stevens. We

³ George Engelmann was a brilliant member of the circle in St. Louis which, at this date, was very actively engaged in the pursuit of science and had organized effectively as the St. Louis Academy of Science. Doctor Engelmann was a botanist of great distinction whose work on the Cacti still remains unsurpassed in accuracy and in its wondrous beauty of illustration. He afterwards became interested in palaeobotany and is to be reckoned among the important contributors to American geology.

had thought that under these conditions you would release Mr. Meek from his contract and that both of them after this season of apprenticeship could be much more useful to you. But the Governor's refusal at once altered the state of things. The question was to go or not to go, and we advised them to go if they felt the courage and spirit to cope with the great advantages the others had, but whether by land or water remained doubtful. You however must have been advised of the reasons which induced them to go by water."

It goes on to say that he had endorsed them to the firm of Lovejoy & Siré to the amount of \$1200, simply because Hall neglected to send on any money.

Engelmann concludes his letter with an expression of reprobation for the dissensions into which the rival ambitions of these explorers projected them:⁴

"I was deeply pained to witness the spirit of rapacity, envy and sickly emulation evinced by most of the persons interested and of this Mr. Hayden is not free himself. He appeared perfectly astounded when I told him that hundreds of years hence more valuable discoveries would be made in the Mauvaises Terres than now by him, Meek, Shumard and all the others together, or that the extent of the country

⁴It is cited here as appropriate to the narrative and in harmony with many similar demonstrations throughout it; from out of which the conclusion stands uppermost that the search for a knowledge of scientific facts, the mere effort, however zealous, to enlarge human knowledge has little genuine humanizing worth either in itself or in its applications. Scientific endeavor must be planted in a soil mellowed by fraternity and watered with righteousness.

was so vast that they might all travel and collect there without once meeting. He wanted to exclude, if possible, those German collectors of whom I had spoken. There is a want of the true spirit of science, the pure love for science in all this. There is on the contrary a selfishness and rapacity manifested in this which grieve me much. Messrs. Meek and Hayden however, have energy and enthusiasm and will, I hope, overcome many difficulties. What the latter lacks in discretion he makes good by his candor. Those Germans are not going but have gone to the interior of Missouri and from there to Arkansas and Texas, principally to collect fishes for Agassiz."

But the young men were off and they harvested an experience which laid the foundation of their useful careers. I would like to reprint here the letters written by Meek to his chief, for his perceptions were wide awake all along these pioneer paths, but an extract from a single one may serve to give a hint of their contents.

FORT PIERRE, *June 19, 1853.*

MY DEAR SIR:

The MacKinac boats have not yet started but will do so in a few days. We arrived here this morning at 7 oclk. and our things are now on shore, but owing to the fact that all the teams and men are engaged in hauling up the goods of the Company, we will probably not be able to open our boxes until tomorrow. We were within two miles of this place last night before dark, but we were compelled to tie up by a tornado which came very near sinking the boat. The Indians, or at least some bands of them, are not very

well disposed towards the whites at this time. Some of them do not come in to meet the Agent, and refuse to accept their annuities. They have sent word to the Company that they will not allow the boat to go higher up than Ft. Clark, and that they will not allow Gov. Stevens's party to pass through this country. Our men, horses, carts &c. will all be ready by tomorrow or the day after. Our things will be taken to the fort this morning, when we will go immediately to work to separating what we are going to take to the Bad Lands from what we expect to use on our way down. Two of our men are good guides and interpreters. One of them is a half-breed who was raised amongst the Indians, and is said to be better acquainted with their habits and customs than any other person in the country. He has hunted all over the Bad Lands. He will take two of his own horses and his Squaw along, and Culbertson says if we have any fighting to do, he will be the last man to leave us.

Drs. Evans and Shumard will start about the same time we do, and have expressed a desire to have us in camp near them during their stay at the Bad Lands. They say Deer, Buffalo, Antelope, Elk and Mountain Sheep are very abundant there, and that our guide can kill more meat than our party can use, though I do not think it prudent to rely upon this means of supply.

I hope you will excuse this incoherent letter, for I am in a great hurry and have to write on a table in the cabin with about two hundred Indian chiefs and braves seated in rows on each side of me. They have come on board by invitation from the Captain to a feast. They are elegantly dressed and their bearing is noble and dignified. One old fellow has just presented a fine Buffalo robe to Capt. Sarpy. He first spread it down on the floor and made the Capt. sit down upon it, when he commenced a long speech which he wound up by presenting the robe, and telling the Capt.

that he looked upon him as one a little inferior to the Great Father. They have given us all an invitation to a Dog feast tonight. I would like to go, but will not have time. The Capt., Dr. Evans and Maj. Vaughan the Agt. will go and they say they are going to eat some of the Dog. I do not envy them their supper.

In great haste Yours &c

Prof. James Hall
Albany, N. Y.

F. B. MEEK

The young men were back in the autumn, bringing with them a harvest which served Dr. Leidy for descriptions of the vertebrates, while Hall and Meek together gave accounts of the invertebrates and Hall had for his material share a large collection of unusual fossils with which to reimburse his pocketbook. But more than that; in summing up the now colossal results which the Far West has contributed to the geological history of vertebrate life, Hall's initiative in this field must not be lost sight of.

Professor Hall's relations with his first assistant, Mr. Meek, have been so often covertly referred to in the literature of the science, that some further word may properly go on record here regarding them. Mr. Meek joined Hall in June, 1852. He was with him for a year before he had become sufficiently expert to make drawings of the quality required for the Palaeontology and just before he started for the West he felt so much the

desirability of security in his relation to his chief that he entered into a written agreement to remain four years. Hall declares that he advised against such a long term agreement but Meek would have it so. Immediately thereupon came the desire to accompany Hayden and even before his return to Albany, G. C. Swallow, who was organizing a survey of Missouri, made overtures to him to urge a release from his engagement. Mr. Meek begged Hall to release him, but Meek had now become acquainted with Hall's procedures and collections and to release him would have been grossly unfair to Hall himself. Mr. Hall suggested to Swallow that he take one-half of Meek's time, failing which he would volunteer to pay Mr. Meek as large a sum as Swallow offered, but at any rate the condition of the Palaeontology would not permit his full release. Mr. Meek did go to Missouri on this part time arrangement, but it all ended in turmoil. I have put down so much, because in one form or another Hall's troubles with his assistants became historic. At this time Hall was the personification of superabounding physical vigor capped by a surpassing ambition and a burning irascibility. He actually terrorized those who came into conflict with him personally or entered as competitors upon his field. It is a fact that he administered *al fresco* pummelings to his men servants and he did not hesitate to make himself impressive on occasion by

snatching a shotgun off the rack over his table. Mr. Meek was the witness of these displays and he was frightened, though in many ways his chief was considerate of him and gave him a large opportunity for increasing his knowledge, communicated to the Albany Institute Meek's important first determination of the Permian system in America and cooperated with him in the account of the Cretaceous fauna of Nebraska; yet Meek, once away safely in Missouri, refused to come back to the terrors of personal relations with this despot in science. That Meek was thoroughly scared is unquestionable; and his fear became greater when Hall, scandalized and outraged by the literal violation of the agreement between them, dipped his pen in vitriol and denounced, to such men as Joseph Henry, his assistant in most unmeasured terms. It was an angry and distressing episode and it brought upon Hall only reproaches and warnings from his advisors and equals; but it was his way, and to him the only way when he believed an injustice was done him. For years he nursed his wrath and the expostulations of those who dared to expostulate taught him nothing. The flame died down in time, but it was sure to flare again when the spark was struck. Such acerbity was all a part of the man in these burning years and it must be estimated in the sum of his doings.

It would seem that Hall had not yet given up all hope for the scientific courses in the Albany University and both Edward Hitchcock and Joseph Leidy had taken part in them in 1853. Agassiz, however, had abandoned connection with them and was now closely busied with Cambridge affairs. This year he was troubled over the lawyer's fees against him in the Foster suit because (Feb. 19, 1853):

"I have been obliged to give up my lectures at the South, at least for this year, which leaves me nothing but \$1500."

Later he writes (July 9):

"Alex, my son, has decided upon studying as his profession, Geology in connection with Engineering, and after giving him a little instruction I now send him out on his first excursion. If you are not too busy, I would thank you to give him a little advice how to proceed. I wanted him to take a look at your collection and go afterwards to Trenton. It is enough if he makes a small beginning. * * * I advised Alex to go right to your house. If he comes at an inconvenient time send him off."

(July 12) "It is sad that even after seven months I am hardly able to deliver my lectures and can not apply myself to any research. Alex has returned after a short trip to Trenton and thence across the State to the Susquehanna Valley. I will send him to you during another vacation when you are at home.

Have you heard from Mr. Lawrence? He said the other day that he entertained the hope of seeing you here some time connected with the Scientific School."

In November, Agassiz writes again at a time when it seemed likely that the Foster suit against Hall might be pressed, to assure his friend of his readiness to help him through. He adds:

"The Museum we are going to get here exists so far as I know, only in the newspapers thus far, though I believe before long Mr. Lawrence will make another donation. A subscription to secure my collections for the University is going around successfully thus far; the faculty is said to be prepared to make up the deficiency of the subscription if the subscription should not cover the sum of \$10,000 I named as its price. This will certainly result and next I shall urge the acquisition [of yours] and your connection with our school; but let us keep that to ourselves."

It was just about this time that Agassiz was greatly disturbed over the rumor of a "plan circulating for an 'American Geological Society' headed by Rogers, with your name on it. * * * I can see nothing but an intrigue of R. with the design of undermining the American Association." Hall was as much surprised as his friend over this project but says he believes it was started by J. W. Foster at the Cleveland meeting, where it was felt that the western geologists had not received proper attention.

An episode of this time too interesting to pass over, has to do with a fleeting sensation in the development of the glacial theory — the Berkshire

Boulder Trains. An intelligent farmer and editor of Pittsfield, Mass., Stephen Reid, wrote a newspaper account, in 1845, of some trains of great boulders which stretched themselves in parallel lines from the Canaan mountains in eastern New York over the Stockbridge and Lenox hills of Berkshire County. These press articles attracted the attention of Dr. Edward Hitchcock, who surveyed the field and gave an account of the singular occurrence in Silliman's Journal for 1845, though he ventured on no satisfactory explanation of them. In 1847, Hall, Desor and Agassiz went over the ground under the guidance of Mr. Reid, though but hastily and without a united conclusion; Desor declaring quite positively that the boulder trains were median moraines; Agassiz hesitating at such an inference because he knew that median moraines start as lateral moraines and he could not find any sides to this glacier; while Hall, having no experience with Alpine glaciers, kept silent though it is evident he was not impressed by the comparison. In the same year William B. and Henry D. Rogers examined the phenomenon and gave a most extraordinary explanation before the Boston Society of Natural History, conceiving that these continuous rows of boulders were landed by a discharge of ice-impounded waters from the Arctic and with the help of various

vortexes and cross currents were strung out into their successive lines.⁵

In 1852, Sir Charles Lyell was in America again on his third visit. He had come as British Commissioner to the World's Fair Exhibition at the Crystal Palace in New York, an errand over which he had little enthusiasm. Tiring of it he begged Hall to make a report for him on the department with which he was specially charged. Meanwhile he went off on geological excursions and he specially wanted to see the place that could give birth to such extraordinary ideas as the Rogerses had promulgated. He arranged first with Hitchcock and C. B. Adams, but finally with Hall, to visit Berkshire, and so together and once more under the guidance of Stephen Reid, the discoverer, Lyell and Hall in September make a survey of the region and by October, Lyell is lecturing in Boston on the subject, in his quick and daring way, having at once found a conclusion which suited him, and he writes to Hall that month telling how delighted Agassiz is at their "clearing up the Canaan mystery," inviting Hall to come over to Boston and hear him. In Lyell's view, the boulders were successively stranded by floating coast ice

⁵ For a keen criticism of the Rogers brothers' interpretation, the reader is referred to Dr. George P. Merrill's analysis of it. *Op. cit.* p. 402.

and so interesting does the occurrence seem to him that he presented it formally before the Royal Institution of London in 1855, and in detail with illustrations in his "Antiquity of Man." Not till 1878 were these boulder trains discussed in the light of more modern interpretations, by E. R. Benton, in the Bulletin of the Museum of Comparative Zoology, where they were shown to be land-ice terminal moraines. Professor Benjamin K. Emerson, of Massachusetts, intimates to me that the phenomena have not since been differently interpreted.

In this year of 1853, an interesting exchange of letters occurred between Hall and Professor Joseph Henry, to whom Hall was wont to appeal for advice as from an older man whose wisdom and equanimity he recognized. Henry had taken charge of the Smithsonian Institution in 1846 and soon after he became involved in embarrassing litigation with S. F. B. Morse over the application of the principles of the telegraph. Henry, as we have already said, had made his initial demonstration of long distance transmission and induction when a teacher of mathematics in the Albany Academy, 1827-1832, and herein laid the foundation of the great triumphs which have been wrought out from these beginnings in electrical power, light and sound transmission.

Henry writes, September 14, 1853:

"You informed me in a conversation some time since, that you recollected having visited me at Albany in 1831 or 1832 and that I showed you how a noise could be made at a distance by causing the needle of a galvanometer to strike against a bell. I am not certain that this was what you said, but I know that this was one of my contrivances at the time. May I ask that you will give me this statement in writing? I do not know that I shall ever have cause to make any use of it, but I wish to file away with a copy of my testimony any facts which may tend to corroborate it."

To which Hall replies:

"I well recollect calling on you at the Albany Academy in 1831 or '32 with a letter of introduction from Professor Eaton of Troy.

Your experiments in "electro-magnetism" were at that time making much talk in the world. Among many things which you showed me were contrivances to produce sound and motion at a distance from the battery by magnetic currents along wires. One arrangement was a battery from which extended wires along the wall of the room for a long distance and at the extremity of these, at a window casing, was fixed a bell which was made to sound by the action of the wires in the transmission of the galvanic current. You remarked *that voices might be extended for many miles* and the same results produced, or that the bell could be made to sound in the same manner at a distance of many miles. I have a recollection of farther observations of yours and of my own inquiries in relation to the matter, the result of which was that communications by signs or

sounds could in this manner be made at any required distance where a wire could be extended.

I have had occasion several times to speak of this fact when present at discussions relating to the invention of the present telegraphing system.

The subject was one with which at the time I was little familiar and I am sensible that there are many details which have escaped my memory. I recollect well my impressions in relation to this visit and when the present system of telegraphing was announced I saw that it was an application of the same principle which you had adopted in your process, the modes of illustrating which might be very various."

Hall was now constantly approached by offers of professional positions and requests for expert service. It is perfectly evident that in these years of the 1850s, when official surveys were starting up here and there over the Palaeozoic states, that if Hall was not at once invited to take charge, he felt himself affronted and proposed himself in perfect self-confidence. He had come to regard himself the logical parent of every such survey for he felt, with some good reason, that they were coming into being as a consequence of the work in New York. He was free to go afield into other official work, and he was eager to venture into private undertakings that would bring enough return to at least enable him to pay his assistants and continue the collections for his Palaeontology. So he allowed himself to be willingly led into an endless variety of land and mining ventures; he continued

his buying and selling of Ohio coal lands; he was interested in North Carolina mining projects; was working with George H. Cook on the Kanawha brines, was consulted upon and evidently became identified with an elaborate project in the Virginia uplands which was to be a vineyard and coal mining development, in which he, Whitney and some of the other Cambridge men, were to take up 10,000 acres of coal lands, cut the timber, set out vineyards, build houses and roads, put in a railroad and bring over from the Rhine a colony of wine-makers. "In four or five years," says the Mulberry Sellers of this enterprise, "we shall have 'sparkling Catawba' to sell at a dollar a bottle." He is frequently in league with Benjamin Silliman, Jr.'s many mining projects and we find him, in the capacity of agent, writing out to England seeking capital for an extensive project in Kentucky coal and iron. Mr. Hall's usual extreme caution in financial matters, in which his saving virtue was habitual procrastination, kept him from grave loss and doubtless brought a fair measure of profit.

Aside from such business approaches and ventures he was continually beset by requests and appeals for endorsements for all sorts of applicants to all sorts of positions. He seems to have seldom refused these appeals but he gradually learned to be cautious with the adjectives he employed. His earliest letters of this sort were on behalf of

geniuses and cherubim of the most extraordinary virtues and he would paint a man looking for a job on the Erie Canal in hues that would embellish a university president. As he became better acquainted with the human equation, he acquired a meticulous care in expression lest some of his words should rebound upon him. A teacher in the Albany Normal School, with the self-confidence natural to a man of limited training, wanted to be professor of geology in Columbia College. He was ridiculously incompetent for such a place but Hall would not refuse him the requested letter. The draft of that letter lies here; it is written on one side of a foolscap sheet, interlined, erased, cut and pasted, and on the other side is another form in different phrasing, but full of excisions and elisions. Both are graceful and irreproachable statements conveying under a few select phrases the intelligence that the man in question was a gentleman. And this gentleman was seeking the same position which was then being earnestly urged successively upon Hall himself and upon Professor Dana.

By 1854 the cherished hope of Agassiz and Horsford that Mr. Lawrence would make it possible for Hall and his collection to remove to Cambridge, collapsed. Horsford writes (June 28):

"It is well to put you at ease about the scientific school. Mr. L [awrence] has told Mr. Agassiz that at the expiration of the five years during which he proposed to give \$1500 [a year] he was at liberty to enter into any arrangements he

might think proper and that he should not continue his salary any longer. The President told me that it was understood in the street that all Mr. Lawrence should give hereafter would be for buildings. They have Agassiz's collection. He has commenced the erection of a house and here he finds himself after seven years. So my dear friend, there is I think a most emphatic end of all the plans that were once cherished by us."

And Agassiz writes (July 6):

"I have had a miserable year. Another like this will do me up. I go tomorrow to Nahant to see what I can do by doing nothing. All our hopes are indefinitely postponed. We no doubt shall have some splendid building from Mr. Lawrence but I see no indication that anything is going to be spent in truly scientific way."

Some letters of 1856 recall an interesting incident which in its day attracted widespread attention.

There was at Union College in Schenectady, a very learned scholar and teacher, Professor Tayler Lewis, deeply versed in the lore and the writ of the Orient, a student of Hebrew, Chaldee and Arabic, and though not a clergyman, a very comprehensive and erudite ecclesiastic. He was a man of much distinction in scholarly circles and his interests naturally predisposed him to a diversion popular at that time — the attempted interpretation of the geological record in the light of the Mosaic chronology. So he wrote a book entitled:

"Six Days of Creation, or the Scriptural Cosmology"; and it was honestly intended rather to magnify the interpretations of geological science than to minimize science in the light of the scriptural record. The book elicited a most extraordinary attack from Professor James D. Dana which was printed in the *Bibliotheca Sacra*. This onset against Professor Lewis seems to the writer the most polished and poignant argumentation in which Professor Dana ever engaged himself. It was of high literary excellence and handled with such surgical delicacy and exactitude that, to the amazement of Lewis and his large audience of listening clergy, he found himself pictured as the very author of an argument which verged on infidelity, even if it did not bring him close to the dismal abyss of atheism. Horror-struck and astounded, Professor Lewis attempted a reply in the pages of the *Bibliotheca Sacra* but he found them well nigh closed to him, while Dana returned to the attack in order to make a finished and thorough operation. Finding all outlet for a rejoinder and a justification shut, Professor Lewis was forced to resort to private publication and it is while he was in the throes and anguish of this justification, "The Bible and Science, or the World Problem," he writes profuse letters on his own behalf to Professor Hall. The appeal to Hall, strong and intimate as it is, was all the more

extraordinary because Lewis, known for his orthodoxy, is calling upon Hall, known to be a member of the Roman Catholic church, for his justification. In a letter of eight foolscap pages Professor Lewis divides geologists into two classes, into one of which, the French and German free thinkers with other radicals, he puts Dana; and the second class, for whom he hopes "to be able to manifest in a satisfactory manner his sincere and hearty esteem," namely, the "scientific men who mingle reverence with their science, men of some modesty, whose consciousness of very little knowledge (greatest even when least in its own esteem) leads them to an adoration of the revealed, or at least an awe of the unknown"; to this class, he very directly intimates, Hall belongs. A few months later, as the publication of his book is delayed, he writes nervously as he feels that the attack upon him "has had influence with many timid clergymen," to know what sort of a geologist Hall considers Dana to be. "Suggestions from you I would receive with perfect confidence both in their weight and their correctness. I could give them in my book in any way you choose, either in your own name or with a distinct statement that they are derived from high scientific authority." It does not, however, appear that Professor Hall allowed himself to be drawn into this theologico-geological controversy, and though it presented the

extraordinary phenomenon of geological odium poured out upon theology, it soon evaporated, the noise of the battle soon died away and its echoes are today only the strange rumblings of a vanishing thunder cloud.

Troubles now loomed menacingly at Albany. A bosom full of live coals, of enthusiasm which must have an outlet, confronted only a dampening official indifference and this was creating not only sympathy but a wholesome resentment among Hall's admirers in the State. Colonel Jewett and Ledyard Lincklaen are deeply concerned and the Hon. E. W. Leavenworth, recently come to Albany as Secretary of State, discovers the situation regarding Hall's work and publicly deploras it. These two letters, one from Lincklaen to Leavenworth and Mr. Leavenworth's reply, paint the picture;

Ledyard Lincklaen to
Hon. E. W. Leavenworth CAZENOVIA 31st March, 1855.

I perceive by a report in the *Atlas*, that you are interesting yourself in behalf of the remaining part of the "State Natural History", the Palaeontology in the hands of Prof. Hall. Though I can claim no greater acquaintance with the subject than that of an amateur, I have still been for many years well acquainted with Mr. Hall and much interested in his progress and success; I have known of the many difficulties and embarrassments with which he has had to contend; have admired his energy and scientific zeal; and wish to express the pleasure I feel at the prospect of a

better public appreciation of him and his labors. This branch of the great State work was the main object of the whole enterprise; a branch of research beyond the means of private individuals; one of great economical importance; and one which by bringing to light scientific facts deeply interesting by themselves and doubly valuable in connection with the discoveries of explorers in other regions and continents, contributes efficiently to the cosmopolitan cause of science. It was and is therefore, a worthy object of State patronage.

It has been, however, half smothered by being gradually associated with a crowd of surveys and publications on other departments of science, departments previously well studied or lying within the means of private students, mammalogy, ornithology, ichthyology, conchology, botany, agriculture, pomology, entomology etc; involving the State in immensely increased expense for publications hardly any of which had much fair claim on public aid, and some of which may be suspected of being mere jobs.

The blame of all this extravagance, the odious imputations so often attaching to persons connected with State printing and publishing, fell unjustly on the really deserving geological department of the work, especially on Mr. Hall's portion of it which was necessarily the longest in being completed; and also on him, who from personal acquaintance I believe to have been entirely free from any motives lower than an honorable ambition, and devoted most sincerely and enthusiastically to his science.

The published statements of Prof. Agassiz are enough to show how disinterested has been his course, and how poor his reward at home — "not without honor, save in his own country". While he has become a standard authority abroad, his work quoted in every European publication on similar subjects, and deemed essential in every foreign

library, he has been immediately at home, to say the least, comparatively unknown and neglected. He has borne everything in silence, and worked on with limited means, in precarious health and in seclusion, remote from scientific associates, collections or libraries, until his work is a monument of his energy, perseverance and ability, honorable to himself and to the State in the name of which it is published.

The other departments of the "Natural History" having come to an end, Mr. Hall's Palaeontology alone remains, the final summing up and matured result of the geological exploration of one of the most interesting and instructive regions of the globe.

It is most desirable that it should be carried out and completed thoroughly, that it may stand as a sound and permanent authority in science, and it is gratifying to one who has (as I have) watched its slow progress and many embarrassments, to see at least a prospect of its fair establishment, and of the long delayed justice due to its author.

E. W. Leavenworth to

Ledyard Lincklaen

ALBANY, *April 6*, 1855.

On my return from a flying visit to Syracuse I find your very interesting favor of the 31st ult. on my table. I agree with pleasure to every word it contains. I came here a year since ignorant of this whole subject. I found Mr. Hall poor, depressed, discouraged, surrounded by no small amount of prejudice. There was and is now no plan for the completion of his great work. I felt anxious on the subject, ascertained in my own mind its importance, merits and value, and resolved if possible to do justice to Hall and complete the work.

But I was all alone, not a person here feeling any interest in Hall, and none of the State Officers any in the work.

To accomplish my object I sent for Agassiz and Dewey,* had a meeting in my office, called in leading Gentlemen from the City & Legislature, interested & enlightened them, and have now a Law under way which I hope & expect will pass, which will enable me to put the completion of the work beyond a contingency, and to do tardy justice to Prof. Hall. * * *

Hoping that all your wishes and my own also may be fully realized in this matter, that the honor of the State may not suffer by a failure to have this great work furthered to its completion, I am, etc.

The law was passed within a year, with its needful appropriations and Mr. Hall had not only won relief with the promise of fulfilment but the agitation of the measure had won him applause and friends. Above all he found in Mr. Leavenworth a stable and enduring anchorage and to him and his memory should be attributed no small measure of the continued success of his *Palaeontology of New York*. But meanwhile, seeking outlets for his entrapped enthusiasm, Mr. Hall had been finding other interests.

* Rev. Chester Dewey, first professor of Chemistry and Natural Philosophy in the University of Rochester.

Geological Survey of Iowa — University of Iowa — Organization and personnel of Survey — Josiah D. Whitney and Amos H. Worthen — Benjamin S. Lyman — Affairs in Illinois — Letters to Norwood and Worthen — Hall excluded from the Illinois Survey — Geological Survey of Wisconsin — History and reorganization — James G. Percival's work — Board of Commissioners, Hall in charge — Warning from his friends — Personnel of Survey; Carr and Daniels, Whitney and Whittlesey — Increase A. Lapham's appeal for a botanical garden — Unsatisfactory organization — Hall made director — Not allowed to complete his reports — His method of acquiring research materials illustrated — Wants to be State Geologist of New Jersey — Helps in Missouri — Seeks charge of Ohio Survey — Geological Surveys of Texas, Mississippi and California — Pacific Railroad Surveys — Asked by Henry to take charge of U. S. Survey of New Mexico — Relations with Sir William Logan and Geological Survey of Canada — Logan and Hall — Elkanah Billings, Palaeontologist — Hall to Logan on classification — Conservative attitude — Correspondence with Dana.

*The Iowa Geological Survey and the State
University*

THE kidnapping of William Morgan from the Canandaigua (N. Y.) jail after his exposure of the secrets of Masonry in 1826, split the country wide apart politically and in New York gave birth to a furiously bitter partisanship.

Thurlow Weed, whose home was in the nearby village of Rochester, had made himself one of the leaders, with the "Silver-Grays," of the Antimasonic party and came on to Albany to establish at the Capital an Antimasonic paper, the *Albany Evening Journal*. In this undertaking he had the support of Lewis Benedict who, upon the subsiding of the Morgan issue, was to become, with Weed, Seward and Greeley, of commanding influence in the Whig party. In the early '50s Mr. Benedict was chairman of the Whig State committee and in his determination to perfect the organization of the Whig party throughout the other states, he traveled into the Mississippi valley and put himself in touch with all the influential Whigs of the region. In 1854, James W. Grimes was elected Governor of Iowa by a Whig and Free Soil majority. Grimes was a Dartmouth graduate, a man of intellectual excellence and refinement and in his first message to his legislature recommended a geological exploration of the State. His suggestion was at once adopted, in January 1855, and the Governor was authorized by a carefully drawn statute to appoint a State Geologist. Concurrent legislation also provided for effective organization of the State University which up to this time had been a slumbering scheme on the statute books. Governor Grimes doubtless had heard of the repute of the New York Geological Survey; for

already in early February brilliant commendations of Hall written by Agassiz and Hitchcock had found their way into his mail; so he turned to his Whig mentor at Albany, Lewis Benedict, for advice with regard to Hall, and Mr. Benedict writes to ask Hall if he will take the place. Though Mr. Hall was deeply engaged at Montreal with Canadian geology and had but just secured renewed appropriations for his own New York work, he at once tells Mr. Benedict that he will accept the appointment and is ready to take the field as soon as the season opens (1855). He writes to Agassiz:

"You may perhaps be surprised that I should be willing to leave New York with my work here unfinished but when you know all the circumstances you will excuse me as I feel assured will every one else. For more than ten years I have carried forward the department of Palaeontology with almost no aid from the State save the salary of \$1500 which has been suspended since 1850 and I have now to depend on other sources of earning my living while I devote all spare time to the Palaeontology of New York. For the past two years I have devoted considerable time to the examination of mines and mineral lands but this pursuit is not precisely consonant with my feelings and I would prefer to be engaged in a Geological Survey while the leisure which its duties will afford in winter I can devote to the completion of the work for New York. * * * During the ten years past I have expended for this object more than \$20,000 beyond all that has been received from the State and now find myself reduced to the necessity of doing something to support my family."

Governor Grimes writes to Mr. Benedict by the first week in March, that he will appoint Mr. Hall, which he does forthwith. Under the law the new geologist was to appoint a chemist and mineralogist with the approval of the Governor and the whole matter of these appointments, together with the affairs of the State University, was of such moment that Governor Grimes came on to Albany in April for a personal conference. He was deeply impressed by Mr. Hall's personality and he writes to his wife (April 21, 1855) regarding him: "He is one of the most modest and unobtrusive men I have ever met."

As together they were to designate the "Chemist and Mineralogist" for the Survey, the Governor suggested John W. Foster. Hall had but just delivered himself of a tirade of denunciation of Foster to Joseph Henry for pilfering his geological map, and he demurred, suggesting Josiah D. Whitney, who was forthwith confirmed in the position; and both appointments were made with the further understanding that the appointees were to be Professors in the State University and draw some part of their salaries as such. The conference went further and the Governor sought Mr. Hall's advice as to the Chancellorship of the State University, in response to which Hall intimated the name of Amos Dean, a member of the Albany bar of much distinction. After conference regard-

ing this with Mr. Benedict and Dr. Romeyn Beck this office was formally tendered to and accepted by Mr. Dean. In his plans for administration of the new university Mr. Dean was intimately dependent on Hall. They two with the advice of Dr. Armsby drew the plan of organization and Dean writes in August of the "splendid opportunity of building up in time, on a right foundation, a great University free and clear of all the clogs and antiquated notions, old fogysm and sentimentalism of our eastern institutions." Chancellor Dean, it may be added, served as first president of the University of Iowa from 1855 to the date of its suspension, 1858, Mr. Hall being its first professor of Geology and Natural History.

Had it not been for the cordial and unyielding support of Governor Grimes and his own untiring and self-confident labor, Mr. Hall could never have succeeded with this distant undertaking. By the closest economy of his time he could command barely a month or two of the year and the appropriation permitted him but one paid assistant, a position for which there were many candidates. John Newberry wanted it, Dr. C. C. Parry who had been on Major Emory's Survey of the Mexican Boundary and was then living at Burlington, Ia., believed he should be permitted to help, and the Rev. W. H. Barris of New York and Iowa wished to join. Mr. Whitney was disposed to be

captious over his appointment and declared he would not serve unless his credit was to be the equal of Hall's. In this matter Hall was generous and Whitney's name appears on the title of the final reports although this was against the wishes of Governor Grimes who repeatedly assured Mr. Hall that he was the sole responsible head of the Survey.

The Palaeontologist at Albany conducted this remote Survey with extraordinary cleverness. He commissioned Whitney to devote himself to the lead, zinc, coal and quarry interests. As his official assistant he appointed an enthusiastic collector of fossils, Amos H. Worthen of Illinois, who was the possessor of the finest collections of crinoids and other fossils yet made from the rocks of Illinois, which were the same as those in Iowa and lay just across the Mississippi river. This engagement was subject to the condition that Worthen should permit Hall to describe his fossils in the Iowa reports. There was some volunteer help on the Survey from Parry and Edward Hungerford, a young man from Silliman's laboratory who could afford to work for the experience,¹ and a number of others.

The key to the geology of the State lay in the section along the Mississippi river, and the task of

¹ Mr. Hungerford afterward became professor of geology at Vermont University.

the surveyor was to follow these outcrops inland. Once their width and bearing were determined it was very simple geology to trace their boundaries with sufficient accuracy to draw them out into a colored map. This was the business of the young men, who followed the sections up the contributory streams and then made traverses across country in mule-drawn wagons carrying their camp equipage.

Mr. Whitney's commission specially charged him with the economic field, but he was actually under instructions from his chief to lose no opportunity to acquire fossils, and when the inevitable rupture between these two men came Whitney declares he could not finish his lead report in time because he had to collect so many fossils. Hall coolly tells him that was his own lookout; he was employed to study the mines.

Such a blithe and frisky survey as it was! The chief made a hasty reconnoitre in the autumn of 1855 and reserved his other visits to the state for the winter meetings of the legislature. The field was left to the young men who for the most part made and carried out their own plans and spent no small part of their time besieging the Governor and the financial officers of the State for money. Iowa was frontier country; settlement had not extended far in from the eastern river bottoms, taxes were so immoderately low that the treasury was often empty. Whitney and Worthen would

get the Governor's orders on the Comptroller, whose warrant to pay they would carry to the Treasurer, only to be told that there would be no money till the next tax collection, which might be months away. So to Albany these warrants must be sent and Mr. Hall had to borrow upon them as best he could from his bank, but always at a sore discount. The personal checks that he sent back to Iowa were subject to another discount. "Funny country this," says Whitney, "where a banker charges me 12 per cent discount on your check and says he is doing it as a matter of personal accommodation to the Survey."

As the Survey progressed into its third season Hall and Whitney felt the need of additional help in the coal fields and J. P. Lesley,² then in Philadelphia, struggling in poverty against a tide of opportunities in iron mining which seemed almost to condemn him to affluence and comfort, wrote to Hall in the spring of 1858:

"I could provide you with a very fine fellow, active, energetic, persevering as a bulldog, regardless of exposure and patient under fatigue, intelligent and with a thoroughbred, scientific mind, but not experienced in geology beyond his field work with me. Were it my survey instead of yours,

² This distinguished geologist, one of the manliest figures in American science; organizer and executive of the Second Geological Survey of Pennsylvania, born in Philadelphia and trained in Yankee theology, was at this time harassed by the adjustments of an engrafted Puritan conscience to the effort of making a living in the

I should certainly put him on to it, with confidence that he would do me full credit and himself too. I am speaking of Ben Lyman."

And so Benjamin Smith Lyman, the writer's friend of many years, distinguished now for his geological researches in the Punjab and Japan as well as his extensive work in Pennsylvania, joined the Iowa Survey and is its only surviving member.³ Mr. Lyman was an untiring worker, tramp-
ing the intervals between the coal mines, sleeping

city of his birth. In 1857, in partnership with his brother Joseph, his stationery bore the printed superscription:

"Geological and other Maps Constructed; Surveys of Coal Lands made; Mineral Deposits examined; Geological Opinions given to guide purchasers, and Reports made to Owners and Agents.

"Orders for elaborate Topographical Surveys from Railroads and other companies will be executed on scientific principles and in the highest style of the art.

"J. P. & J. LESLEY, JR.,

"Office, 407 Walnut Street."

Business was not paying and he writes to Hall in November:

"I am obliged to lecture this winter. Can I get a chance to deliver one or two paying lectures on *Iron, etc.*, or on some literary subject in Albany and Troy?"

And in the spring of 1858 he was planning to join Owen's Geological Survey of Kentucky as "subassistant, crops, camp and means of transportation, and a per diem of \$5.00."

Many sketches of Mr. Lesley's life have been printed, none, however, a more intimate and sympathetic portrayal of his career than that by Professor William M. Davis for the Biographies of the National Academy.

³ Since this was written Mr. Lyman has joined the other members of that survey.

where he could find some haphazard farmhouse on the prairie, but he nearly broke up the organization by deciding to have a wagon-maker construct for him a great cart of five foot gage, big enough to travel and sleep in. The wagon-maker saw an opportunity of advertising his business and so he painted the great wagon in a style to attract attention—the wheels yellow and the box red. But who was to pay for this gorgeous wagon? Mr. Hall declared he didn't know, but would ask Governor Lowe (Governor Grimes was now United States Senator) who could not quite see where the money was coming from, though when the treasury could afford it the insistent wagon-maker received a small payment on account. This great State chariot with its bright red box and lemon yellow wheels was the subject of vast concern to the State authorities but it never became Mr. Lyman's triumphal car. It was not paid for when the Survey was discontinued in 1859, and by that time Mr. Lyman was presenting his *lettres de cachet* from Hall to his old friend the Count de Verneuil, at Paris.

The Geological Survey of Iowa had the staunch support of the citizens until an opposition which was accredited to the State University terminated the appropriations before the State was covered, and the final report, which was in two books called "Volume I, parts 1 and 2," dealt only with the

eastern part of the State. It seems very clear that if Mr. Hall had chosen to take an active personal part in urging its continuation it would have gone on. But he had already accomplished his objective by producing as one of these volumes a beautifully illustrated account of the palaeontology of the State which he may well have thought would not be much improved by further explorations and which, next to his New York volumes, was of highest merit. He had levied on every possible supply of fossils and with the aid of Mr. Worthen's collection he made a contribution to the science which is today of fundamental value. Mr. Meek and Hall's new assistant at Albany, Mr. Whitfield, delineated the beautiful plates of scores of species and as a mark of good feeling all around the author distributed the honors of immortality with impartial hand among his associates, as bear witness some ten species named for Mr. Worthen, a *Spirifer Whitneyi*, a *Spirifer Hungerfordi*, a *Spirifer Parryanus*, and another which played a serious figure, it is said, in Governor Grimes's campaign for the United States Senate—a magnificent and imposing creature which Hall chose with eminent propriety to christen with the name of his friend, *Spirifer Grimesi*, and which the Governor's political opponents declared he had himself named in glorification of his own achievements before the people of Iowa!

Governor Lowe, to whom jointly with Governor Grimes the final reports were inscribed, took great pride in the books and in their wide distribution, for which generous provision was made. Mr. Lowe's personal regard for Professor Hall is shown in a letter of September, 1858, wherein he asks Hall to get the Albany banks to cash \$50,000 Iowa 8 per cent treasury warrants to help the completion of a State Insane Hospital for which they had no money.

It does not appear that either Professor Hall or Professor Whitney ever delivered a lecture in the State University to whose faculty they belonged.⁴

⁴ As a very appropriate addendum to this story, I give here part of a letter recently received from President Emeritus Thomas H. Macbride, of the University of Iowa, which has reference to the real influence which Hall's work exerted on the fortunes of that great institution:

"With regard to Dr. Hall's connection with the University, I have made a transcript of the announcements issued by the University in those early years, from the bound volume in the University Library which contains these records. The first transcript presents the names of the faculty and the departments with which they were associated. This for 1856 and 1857. The second gives a more complete description in each case, but I have taken the trouble to write out the outline of each professor's subject as presented by himself, in the case of Dr. Hall and Dr. Whitney only. I believe you will find both of these outlines interesting, and I beg to call your attention in the last mentioned to the purposes which the professor undoubtedly had in mind. This is indicated by his fourth item, the "application of all these to Agriculture," a sort of premonition of the work which the State is now doing in that direction, since we have one of the greatest schools of agriculture in the

The Illinois Geological Survey

The Iowa work having been successfully done, Mr. Hall indulges in one of his extravaganzas of tactlessness. For his assistant, Mr. Worthen, he had acquired the highest esteem and beyond doubt the excellence of the report was in generous degree due to his diligence and devotion. There was a

country. I beg to say also that, to begin with, the University was organized for the purpose of preparing young people for service in the public school system, at that time just beginning its history. It turned out that the funds of the institution were insufficient from year to year to meet expenses. Accordingly the work of the University was actually suspended from 1858 to 1860. This was true of all departments except that of education. Now you see the whole story. The University was organized primarily to do normal work; in its science, primarily to do the work of the agriculturist, and the issue of it is that we have a great University doing university work, a great normal school educating teachers, and a great state college working for the farmer. To this latter accomplishment Dr. Hall's work particularly contributed, although his magnificent study of geology as a pure science has made the strength of the liberal arts college in that science notable ever since.

Yours very sincerely,

Thomas H. Macbride."

The outline of Hall's courses is as follows:

Department of Natural History.

James Hall, A.M., Professor.

The subjects to be taught in this Department are

1. Zoology, including the Philosophy of Natural History.
2. Botany, including the Laws of Vegetable Life.
3. Mineralogy and Geology.
4. The applications of all these to Agriculture. The large collections in Mineralogy and Natural History which have been accumulating during the progress of the State Geological Survey, will shortly be arranged in the Cabinet of the University.

movement afoot in Illinois, Mr. Worthen's State, late in 1857, to reorganize its geological survey, which was leading a sluggish existence under the direction of Dr. J. G. Norwood. Mr. Worthen sought the appointment; likewise Mr. J. H. McChesney, while Dr. Norwood, who was a most amiable gentleman with the faults of amiability, desired the opportunity to complete his reports. Mr. Worthen turned to Hall for help and received it in full measure, for he not only wrote favorably to Governor Bissell regarding him but he sent the following letter to Hitchcock, Agassiz and Dana:

MY DEAR SIR:

ALBANY, *Dec.* 28, 1857.

The Governor of Illinois contemplates making a change in the organization of the Geological Survey of that State, or in other words replacing Dr. Norwood by a more efficient man. My assistant in the Iowa Survey, Mr. A. H. Worthen, who is a citizen of Illinois, is an applicant for the place and quite competent to fill it. Indeed I think, without disparagement to any other Geologist in the west, that he understands better the sequence of the formations and is better prepared to identify them, than any other one. He is industrious and persevering, and would be untiring in the pursuit of his science could he have such a position.

I have ventured to ask you, on the strength of my representations, to give Mr. Worthen a letter of recommendation, and I pledge myself that if he receives the appointment the work shall be done in a creditable manner and a manner of which the State and the Geologists of the country shall have good reason to be proud.

If you feel disposed to give such a letter please address Hon. William H. Bissell, Governor, Springfield, Ill., or you may if you please inclose it to me and I will forward it.

The Governor has said that there shall be no favoritism, but the choice shall be determined on the merits of the applicants, and testimony of scientific men.

I know of only one other applicant, and he has had very little experience in such work and I think on the terms above stated would not receive the appointment.

With kind regards &c.

Believe me very sincerely yours

JAMES HALL

Thereupon, moved by a generous impulse toward a discredited colleague, he shortly sent this letter to Dr. Norwood:

ALBANY *Jan. 9, 1858*

MY DEAR SIR:

I have learned from several sources that Gov. Bissell proposes to do something in regard to your Geological Survey and I have written a recommendation for Worthen in case any changes are made, for I think him worthy of the place.

If you will understand me, I have no opposition to you, nor will I do anything to affect your position. If it is in *any way* possible for me to help you to bring before the public the results of your labors of so many years past I shall be most happy to do so. Why will you not at once do something to put the matter in form and to divest everybody of cause of complaint? You shall have all my assistance and Worthen's too so far as I am concerned if you will only consent to do something that will put you right before the public and maintain your reputation among scientific men.

Do not be offended at my remarks for I mean no offence.

I shall be in Springfield in February and if you can induce Gov. Bissell to postpone action till that time I will see what can be done to help to a reconciliation of all parties and claims, and help you to earn your just reputation, so far as my poor efforts can be available.

With kind regards

Yours truly

JAMES HALL

Dr. J. G. Norwood

Mr. McChesney, the third candidate, was the owner of another large and unstudied collection of fossils from which Hall's eyes and his desire could not be turned and he personally writes to him intimating the importance of having his fossils described and how gladly he would describe them in case he, McChesney, should receive the appointment of State Geologist!

It was a daring act, this attempt to ride three horses at once and the kindly Providence that usually watched over him turned its smiling face to the clouds on this occasion.⁵

It is easier to guess than to picture the result of this singular procedure, for naturally each one of the three men presented his documents to Governor Bissell and Hall was presently made aware

⁵ "I have found that Providence is usually on my side," he said to me thirty years later, the morning after the death of a vicious enemy in office who had declared his intention of having him displaced next day.

of the fact that where he had lately had three friends he now had four enemies, one of whom was the Governor of Illinois. It was a lamentable and extraordinary procedure; lamentable because it led to estrangement and bitterness between Hall and Mr. Worthen, who received the appointment and held it fourteen years with great credit to himself, his state and the science; and from all part in this work, rich in its palaeontology, Hall was excluded. Mr. McChesney came on to Albany and joined the New York corps for a little while, but his collection lagged behind him in Illinois and eventually fell to the service of the Illinois men.

The Geological Survey of Wisconsin

On an earlier page we have made reference to Increase A. Lapham, a farmer's boy and stone-cutter from Palmyra, N. Y., and frequently to Ezra S. Carr, Hall's young assistant during the Fourth District Survey. These were both men now and both had become residents of Wisconsin. Lapham had long been the leading spirit in science in the State,⁶ a man of wide and varied interests, while Carr had more recently come to a professorship in the State University. Wisconsin

⁶ "By profession a civil engineer, he had become at an early day a faithful collector, observer and recorder of natural phenomena in nearly all leading lines from bed-rock to sky. He was at once a botanist, a zoologist, an archeologist, a geologist and a meteorologist. He was a distinguished example of the best order of the old

had organized a geological survey in 1853 and its fortunes had ebbed and flowed since that time. Edward Daniels, a political apothecary, had been the first official appointee and he had been promptly succeeded by Dr. James G. Percival, the poet-geologist. Percival was a singular and extraordinary figure in American literature and science, a ragged Ishmaelite whose soul was ever bursting into song, a hapless genius who knew no friendly voices except those of the woods and the rocks, who bubbled out his real soul in rime and wrote the most atrocious and barren of all geological documents. "His clothes were shabby; his trousers more often than otherwise frayed at the bottom and patched in various places by his own hands. Eight months of the year he wore an old glazed cap with ear-tabs of sheepskin, the woolly side turned in, and a gray cloak. Whenever the cap came off it revealed a classic head and for the first time one would notice the fineness of the features and eyes of unusual splendor. * * * "He became a familiar figure in the fields and woods of Wisconsin and was generally known as Old Stonebreaker. Some of the boys made sport of him but the little children all over the State knew

school of all-round students of natural science. Probably we owe to Dr. Lapham, more than to any other single individual, the establishment of our Weather Service. He served as the first general secretary of the [Wisconsin] Academy." (Professor Thomas C. Chamberlin in *Science*, July 2, 1920.)

and loved him. He was always poorly clad and suffered greatly from exposure in winter.”⁷ From a cold contracted in December, 1855, Dr. Percival died at Hazel Green, Wis., the following May.

By 1856 there was a serious purpose to discontinue the appropriations, but upon the death of Dr. Percival the legislature of 1856-57 formed a new organization under a Board of Commissioners made up of Hall, Daniels and Carr. It may be repeated that Hall was then not only busy with the Iowa Survey but had an important engagement with Sir William Logan on the Survey of Canada, was the president of the American Association for the Advancement of Science, an office which brought serious duties, and the New York work was now moving apace under its renewed provision. It was just at this time that his devoted friend Newberry called out his warning:

“I venture to suggest again what I have done in person, that you are attempting too much, more than flesh and blood and brain can do. And while in one sense you have a right to do with your own time and ability just what you please, it is equally true that your friends and the friends of Science are involved in the consequences of your acts, and would suffer an irreparable loss if by care and overwork your health should be permanently broken.”

In many ways Mr. Hall was excellently equipped for the Wisconsin Survey. He had had an exten-

⁷ F. G. Cogswell: *James Gates Percival and His Friends*, 1902.

sive experience with the old rocks of the northern area in his work with the Foster and Whitney survey and in various private enterprises, and with the southern region he had an even longer standing acquaintance. The present arrangement made him virtually a chief, but almost of necessity chief *in absentia*, Dr. Carr acting largely as executive officer on the ground and Mr. Daniels being merely an uncomfortable tradition and a more or less active obstacle to the operations of the survey. To all these men Mr. Lapham acted in the capacity of guide, philosopher and friend, taking no official part upon its rolls though actually contributing to its results. Mr. Hall immediately entered into a contract with Josiah D. Whitney to extend his work upon the lead region into Wisconsin, and thus this important study eventually covered the lead country of three States, Iowa, Wisconsin and Illinois; and also with Colonel Whittlesey, his former associate in the Foster and Whitney survey, for the study of the mining field south of Lake Superior. Mr. Hall visited Madison in the early winter of 1857 to confer with Governor Randall and make such provision as he could with reference to a continuance of the appropriation, but he could not find time to take the field. Matters did not go very smoothly and the form of organization was not to his liking; Mr. Daniels was a chain and ball on his leg; Dr. Carr did not prove a man of

much initiative; Whitney was working under a year by year contract and Whittlesey kept writing to his chief suggesting that Hall resign in his favor. Worse than all, from Hall's point of view, there was no one collecting fossils, except Mr. Lapham in a desultory way, and there were few private collections to borrow from. Public sentiment in the State was strongly behind the development of the mine fields as Mr. Hall had planned it, but this phase of the work called for all the available funds and nothing was left for palaeontology. Hall quite correctly assumed that if his reports on the geology of Wisconsin were to have lasting worth and meet the immediate demands of the science they must present something besides a statement of probable mineral resources and hypotheses of their origin. The experience in Iowa had made this very clear and it is needless to say that his judgment was right, for today the chief value of his Iowa report lies in its Palaeontology. He fretted over the situation as he saw the appropriation entirely absorbed by Whitney and Whittlesey and he quite overlooked the fact that he had made an agreement with the State to carry on a natural history survey and that the law specifically called for certain botanical work. He is reminded of this by Mr. Lapham in a letter which well displays its writer's fine vision and large hopes for his State — regardless of appropriations:

MILWAUKEE *April 2, 1857*

MY DEAR SIR:

Of course you are aware of the success of the efforts to obtain an appropriation for the continuance of the Geological Survey of Wisconsin. I beg to call your attention as one of the commissioners to the clause in the law requiring a full collection to be made of "cultivated and other useful plants." Now as there are but few plants that are entirely useless I take it that this includes a pretty large share of the vegetable kingdom. What I wish to suggest is that this collection should include not only the herbarium of dried specimens arranged in books, but also seeds, woods, and generally all curious and useful vegetable products, with many of the articles prepared from the same. Such a collection properly arranged with tickets showing the name, origin, uses, etc. of each article could not fail to be a very valuable source of information for the people who would have free access to it.

I know of but one such collection in the world; that at the Kew Gardens near London under the direction of Sir W. J. Hooker. This "museum of economic botany" is found to be of great service not only to the scientific botanist, but to the merchant, the manufacturer, the physician, the chemist, the druggist, the dyer, the carpenter, the cabinet maker and artisans of every description who find here the raw material employed in their several professions correctly named and accompanied by some account of its origin, native country, etc., either attached to the specimen or recorded in a popular catalogue. Over 300,000 persons visit this museum annually, thus showing the deep interest the public feel in it; many of them are attentive visitors, taking notes, and making drawings of articles exhibited. This collection appeals directly to the faculties and understandings, showing the practical uses of the study of Botany,

and the services thus rendered to mankind. It has done more to recommend and popularize the science that communicates a knowledge of the vegetable creation than all the princely palms, gorgeous water-lilies, elegant ferns, etc. in the "tropical houses" of those noble gardens. Its utility is further testified by the remark of not a few visitors — "Now we see for the first time in our lives, and on a large scale, a practical application of the science of Botany."

In arranging and distributing the functions of the survey (see sec. 2 of the act) would it not be well to appoint an assistant well skilled in botany (*like me for instance!!*) to take special charge of this portion of the work and to apportion a proper share of the appropriation to meet the necessary expenses?

Hall was an appreciative botanist but he could not undertake to inaugurate Kew Gardens at Madison on an appropriation for a Geological Survey which was so meagre as to starve out palaeontology. In the hope of bettering the situation Mr. Hall with the aid of Mr. Lapham and his large circle of friends induced Governor Randall to recommend a change in the law so that in 1860 Hall became the responsible head, with the title of Superintendent. In the meantime Hall had been using his private funds for the collection and illustration of palaeontological material and now proceeded to get together his final report which was to be, like the Iowa report, one volume of general and economic geology and one of palaeontology. The reports by Mr. Whitney and Colonel

Whittlesey and a chapter on the topography and geography by Mr. Lapham, were thus printed, but it became evident before the printing was through that the State would not permit the preparation of a second volume to cover the palaeontology. With the help of Mr. Lapham a list of fossils was made up and printed at the end of the report and when this book was completed the work was done, the Survey over, the appropriations closed and Hall was left with the expensive drawings and valuable manuscript of a volume on the Palaeontology and a claim against the State for expenditures which was never paid. He had received short shrift at the hands of the legislature. If the Executive had been endowed with the far-seeing intelligence of Grimes and Lowe of Iowa, Wisconsin might have had from this undertaking a scientific monument of enduring importance instead of a record with a purely transitory value. To Hall this Survey was ever a source of chagrin and indignant mortification. He did, indeed, describe its fossils but the credit therefor went to the New York reports which contained them, rather than to the State which should have treasured them. His defeated hopes lay in this, that his activities in the Mississippi Valley had lifted the veil from an unbelievable treasure among the fossil Crinoidea — the sea lilies. He had portrayed them beautifully but only in part in his Iowa volume and to Illinois he had

hoped to dedicate the rest. His hasty intervention in the affairs of Illinois had destroyed that hope and so for Wisconsin he reserved these treasures, even though the most of them came from rocks which might have been in Wisconsin if the earth had been otherwise partitioned.

As an illustration and a lesson to later generations of palaeontologists, Hall's procedure for such investigations and his method may in this case be set down. He had already arranged with Worthen for the use of his Crinoidea in the Iowa report. They were used, though a part was reserved for a future occasion. In Iowa, he had become acquainted with Charles A. White of Burlington who had splendid crinoids, but White had loaned them to McChesney of the Illinois Survey and he was unwilling to recall them. Hall thereupon asks Governor Grimes to request Mr. White to loan them to him. The Governor, full of the milk of palaeontology, does so and White again declines. Hall then intimates to Mr. White that he would like him to come to New York and collect crinoids for him there. Mr. White did come to New York and there uncovered, with the help of Mr. Meek and Christian Van Deloo, the best fossil collector Hall had ever trained, the finest of all Devonian crinoids. While Mr. White was thus engaged for several seasons, Hall had the use of his Iowa material. Becoming acquainted with the collection

of G. M. Kellogg of Keokuk, Hall requests Governor Lowe to ask Mr. Kellogg for the use of it. Mr. Kellogg responded favorably on condition that he be permitted to join White in New York. Mr. Kellogg came to New York with his treasures. Meanwhile matters had gone wrong with McChesney in Illinois and he had lost his position though he still kept possession of his crinoid collections, and so, in his extremity, McChesney was brought to Albany and sent out collecting. Doctor Edmund Otis Hovey the founder of Wabash College at Crawfordsville, Indiana, was then uncovering the wonderful crinoid beds which had been discovered in 1842 and are now known and represented in nearly every institution where geology is studied. To Doctor Hovey, Hall sent Mr. White as his ambassador preferring his request for permission to study and describe these new marvels and Dr. Hovey writes (Oct. 17, 1860):

"Mr. White we found a very pleasant intelligent gentleman and truly faithful to his employer. My son [Horace C. Hovey] who has acquired considerable knowledge of palaeontology has had a strong desire to describe some of our new species, but he is not now in a situation to do it and from Mr. White's representations of your plan I suppose delay would be undesirable so I concluded to forego the pleasure of indulging his wish hoping to secure to the college and to science a greater good by placing them in your hands."

It was thus Hall laid the foundation for his work. His collections must be extensive in order to secure his conclusions and of "duplicates" he refused to know anything, for under the requirements of scientific investigation there are none.

Geological Survey of New Jersey

New Jersey began its State Survey under Henry D. Rogers the year before New York started and concluded it in 1840. In 1854 a new Survey was proposed and Professor Hall went out after it by an appeal to Governor Rodman W. Price through William L. Marcy who as Governor of New York had given Hall his first appointment and who was now President Van Buren's Secretary of State. Governor Price writes to tell Hall why he could not appoint him, but in designating Dr. William Kitchell, a citizen of New Jersey, as head of the organization, he instructed him to make Hall the Palaeontologist of the Survey. By 1855 Hall is receiving materials from Kitchell and George H. Cook, who was assistant geologist in charge of the southern division of the State, and Dr. Joseph Leidy wrote to him in March 1856, "I would like to take off your hands that part of the descriptive palaeontology of New Jersey including the vertebrate remains. The pleasure of rendering you an assistance in this respect I should consider ample payment especially as I am already so deeply in

your debt." Mr. Hall was obviously indifferent to this organization. Mr. Cook was the only redeeming element in its local personnel but he alone could not justify it; and so by August 1857 it had expired.

Other Geological Surveys

In the rich and ardent years of this decade still other States and other representatives sought out Hall and besought him or his help. In 1853, G. C. Swallow of Columbia, *Missouri*, who had been put in charge of the new Geological Survey in that State takes "the liberty to address you to ascertain whether your services can be obtained in our Geological Survey. * * * Your distinguished labors make your connection with the Survey very desirable." Hall did not want this position but he wanted to be asked; so having been asked he forgot to answer the letter for a matter of three months. Meanwhile Swallow is gravely embarrassed and Hall is beset by the other Missouri men, Dr. H. A. Prout and Dr. Litton for endorsements to the position offered to himself.

As early as 1853, Dr. John S. Newberry in *Ohio* was urging a properly organized survey for that State and by 1854 the project was before the legislature as a plan very like that of the New York Survey — the State to be divided into six districts each of which was to have its chief geologist and

assistants. Nothing came of this movement for a long time, but in 1856 Hall writes to Newberry from Montreal expressing the desire to be put in charge of this survey. Counting their chickens while still in the egg, Newberry says he wishes to be in charge but that Hall shall have the Palaeontology. Early in January 1857, Governor Chase recommended the appropriation and the candidates lined up in impressive array — W. W. Mather, Charles T. Jackson, Colonel Whittlesey, Orestes St. John, D. D. Owen. While the effective local sentiment favored either Dr. Newberry or Prof. E. B. Andrews, the outside influence as represented by Hall and James D. Dana was behind Newberry. But nothing happened; Dr. Newberry sailed for San Francisco to join, as Surgeon and Naturalist, the exploring expedition through the Colorado river under Lieut. J. C. Ives and Ohio waited many years for her Survey to take form.

In 1858 Hall is asked by Joseph Henry to designate a geologist for *Texas* and he writes to Governor Rumels recommending Benjamin F. Shumard, a brother of G. C. Shumard of Missouri and who had led the expedition to Oregon when Meek and Hayden were on their way to the Mauvais Terres.

In *Mississippi*, a German named Ludwig Hafner, endeavoring to hide under the cloak of respectability, took the name of Lewis Harper and

had received the appointment of State Geologist. He proved to be incompetent and his immorality was so gross that his successor in office, E. W. Hildgard, writes in May 1858 begging Hall for his moral assistance and the help of his example in rehabilitating the science among his people; he should address the Governor, setting forth the high aims of geology and the devout and sincere purpose of its adherents.

In *California*, Dr. John B. Trask, Surgeon in the U. S. Army, had been for three years, 1853-56, the official geologist and his reports were of a high value. Hall's eye and mind sweeping the whole field of American geology just at this time, felt that Dr. Trask could "not do better than to furnish me with specimens, sections, etc., of the beds * * * giving me thus the means of bringing the subject more fully and forcibly to our geologists."

The surveys across the great plains and mountains of the unknown Far West carried on for the chief purpose of establishing a route for a railway to the Pacific Coast were active during the years 1853-1857. They were known broadly as the *Pacific Railroad Surveys* and in nearly every instance were accompanied by a naturalist and geologist. The reports of several were beautifully executed books illuminated with costly colored plates of birds and beasts with Indian and buffalo-dotted scenery and they were printed to such

enormous editions that the country children had an unlimited supply of pictures for their scissors. But they were of great worth and Mr. Hall made contributions to several; to Lieutenant Whipple's Survey of the 35th parallel through New Mexico, Arizona and Southern California; to Captain Pope's Survey of Texas; to Lieutenant Williamson's Survey of California. He examined for President Hitchcock the fossils brought in from Captain Marcy's Survey of the Red River Country and he reported on the fossils of Lieutenant Emory's Mexican Boundary Survey. In 1857 the Government had in view a more formal survey of the territory of New Mexico and Professor Henry wrote from the Smithsonian Institution suggesting that Hall take charge of it; to whom Hall sends this very apt reply:

ALBANY, *December 26, 1857*

MY DEAR PROFESSOR:

In reference to the Geol. Survey of New Mexico I must first thank you for your expressions of good will, and the confidence which you express. Could a survey be properly organized I should like very well to have the direction of it, and I believe I could bring out results of much importance both to the science of geology and for the advancement of utilitarian interests. I would like also to organize a corps, where I could give several younger men than myself an opportunity of earning a reputation in geology which they might not so readily attain, even if left free to work independently. After all the explorations made during these past years, very little, it seems to me, has been done towards

giving us a true idea of the geology of the great Rocky mountain region from its northern to its southern extremity on this continent, and yet by a proper organization and the adoption of some system in the mode of observation, and a proper comparison of the materials collected, half the labor that has been expended would give us a most complete knowledge of the structure of this portion of the country and the nature of its products.

I do not feel disposed to enter the lists among the many who will doubtless apply for this appointment, and unless it could be awarded to me upon other grounds than the support of numerous friends, both scientific and unscientific, I should scarcely feel disposed to contend for it. I shall leave the matter entirely in your hands at present, and if the Secretary of the Interior is disposed to consult yourself and other persons whose opinion should govern his action in the matter, I will then consider myself a candidate for the appointment. I would like such a position for a few years with the proper means at my disposal in order to show what are my ideas of a geological survey and the manner of placing its results before the public. If the appropriation should be made it ought to be sufficient to secure several of the best geologists in the country who are able in their respective departments of the science. You are pleased to speak of my claims to the appointment from my devotion to the science, reputation, etc. If devotion to the science, and untiring labor, with a sacrifice of every personal comfort and convenience as well as of pecuniary means, can entitle one to such consideration, then I claim that I have earned this distinction.

Geological Survey of Canada

From the early days of this great Survey, Mr. Hall's relations to its founder and director, Sir

William Logan, had been intimate, professionally and personally. In 1843, Logan had begun the career of his survey by revealing the palaeozoic rocks of the Gaspé Peninsula, and in seeking light upon them he was in Albany in the following winter. Telling De La Beche, the director of the British Survey, of his experience during this first year, Logan says: "I worked like a slave all summer on the Gulf of St. Lawrence, living the life of a savage, inhabiting an open tent, sleeping on the beach in a blanket sack with my feet to the fire, seldom taking my clothes off, eating salt pork and ship's biscuit, occasionally tormented by mosquitoes. I dialled⁸ the whole of the coast, surveyed and counted my paces from morning to night for three months. * * * I have just returned from a visit to Albany where I have been studying the New York geological collection. * * * The condition of the rocks of New York and the certainty with which their order of superposition has been determined, makes that region the key to the geology of a large portion of the North American continent."⁹

These two men were concerned with problems so intimate and, though of different inclinations in

⁸ Sir William records that he lost his dial-compass somewhere near his camp at Little Gaspé on the Forillon peninsula, in 1843. This compass was ploughed up by a farmer's boy in 1915.

⁹ B. J. Harrington: *Life of Sir William Logan*, 1883.

this science, were so cast into supplementary parts of one great geological province that their relations were continuously and jointly directed to the same end. It should be recorded without fail or want of emphasis that these personal relations between Sir William and Professor Hall were openly harmonious throughout Logan's leadership of the Survey which he resigned in 1869.

When the great Canadian geologist lifted the curtain which veiled the panorama of the rocks in Gaspé,¹⁰ he brought to light a new world of palaeozoic life, and of those days of the early '40s before Hall had issued his *Palaeontology I*, and Sir William came to him for aid, he wrote at a later year *reminiscently*:

"The first volume of New York was not then published but by your kindness it was given to me in advance of publication and I was enabled to complete a tabular list comprehending every fossil known from these rocks. Many of these were not specifically named but I was permitted to make copies of such drawings as you had. Without this I should have been under the necessity of establishing by very laborious comparison a set of palaeontology rules for myself."

¹⁰ In the beautiful village of Percé, fronting the Gulf of St. Lawrence, in the heart of the region where Logan began his work, stands a picturesque monument to his memory and his powers—a bronze portrait tablet attached to an upstanding rock dome and embraced by hillside greensward; all together constituting the "Logan Park."

Not until Hall had issued his *Palaeontology* III could the Gaspé discoveries be set forth with their full value because of their late geological age, nor were they until Logan prepared his most important and enduring work, the "*Geology of Canada*" (1863), a book which is still the guide to the geology of the eastern Dominion.

Often Hall was called to Montreal in conference and by 1854 he was charged with the preparation of the 2nd *Decade* (as Logan styled the palaeontological monographs of his Survey) out of which he developed the beautiful study of the Graptolites which Sir William had discovered in the slates of Point Levis; the most elaborate investigation of this singular and important group of hydrozoan corals which had yet been undertaken. Mr. Hall could not release this monograph for publication for eleven years (1865) but these years helped to maintain intimate relations with Logan.¹¹

Hall loved his associations with Logan; he and his family loved the great Catholic city of Montreal and Logan was constantly pleading with Hall to give up New York and take up with him in Canada whose palaeontology was sparkling with great

¹¹ In the preface to the *Geology of Canada* (1863) Logan says: "In addition to the general benefits obtained from the investigations of Professor Hall in his own division of the State of New York we have to express obligation to him for the assistance rendered to Mr. Murray in 1856 in tracing out boundaries of the Upper Devonian rocks in a part of the western peninsula [Ontario]."

promise. The presence and influence of T. Sterry Hunt, the brilliant chemist of the Survey, a fellow Catholic, almost persuaded him. And in after years Hall was wont to lament, whenever he had tread on some nettle alongside his path in New York, that he had not given heed to the voice of Sir William, which in 1854 gave him a positive call to come.¹²

The two men were much alike; both in physical appearance and in experience as pioneers in *Palaeozoica*. Logan, the elder by thirteen years, was the more philosophical thinker, the more independent and imperturbable executive; and as such he checked and counterpoised Hall's sanguine pur-

¹² On the occasion of a Logan commemorative event at the Logan Club in Ottawa in 1893, Hall wrote to the Secretary, Mr. William McInnes:

"It was a great pleasure to me to have the acquaintance and friendship of the first director of the Geological Survey through a period of many years, and his annual visits to me in Albany, from the very beginning of his work, were looked forward to with pleasant anticipations, which were always more than fulfilled in the reality. Working in different directions in the science, he devoted to physical and stratigraphical geology, and myself to palaeontology, rendered our discussions both pleasant and profitable to each, and those visits were always red-letter days in my calendar. Afterward in association with Sir William Logan and the work of the Survey in Canada, I became more intimately acquainted with the plans and purposes of the Survey and learned to admire the wisdom and discretion of its director. My relations with Sir William and the staff during the little time I was associated with the work were of the most cordial and friendly character and it has been the great regret of my life that I did not join the Survey when I had an opportunity of doing so in 1854."

poses and unquestionably directed his activities. As Hall would not desert New York, Elkanah Billings was made palaeontologist of the Canadian Survey in 1856, and thereafter Hall's relations to it became of necessity more formal. Mr. Billings, a barrister in practise at Bytown (Ottawa), had become so enamored of natural history that after he had been well established in the practice of the law, he laid aside his profession for the pursuit of science. Mr. Billings had already acquired some experience as an editor and when he formally bade adieu to his legal practise he established the *Canadian Naturalist* which still remains after sixty years the leading periodical of its kind in the Dominion. Mr. Billings's repute for investigations in palaeontology was even then established and as Palaeontologist of the Survey, a position which he filled for twenty years, he accomplished brilliant work. His love of the science, fortified by his training in acute analysis and cautious conclusion, made his work of first rank and in the writer's judgment its quality as especially exemplified in some of his more elaborate researches has not been surpassed in refinement in the field of palaeozoic palaeontology: He was gentle, generous, just and loyal. Just before he entered upon his official duties he wrote to Hall (March 31, 1856):

"Every student of American Palaeontology owes you a debt that can not be easily paid. No one feels this more

than myself. How happy we should all be here were you to honour us with a visit * * * I received a letter from Sir W. E. Logan on Saturday night. I sincerely hope his bill may pass and had written something in its favor the day before in the *Ottawa Citizen*. How much I should like to be attached to the Survey."

And for these first years he is in close consultation with Hall over the wonderful things Murray had brought in from the Island of Anticosti and Logan's great collections from Gaspé, and is securing publication of Hall's papers in the *Canadian Naturalist* and the *Canadian Journal*. Mr. Hall had exerted no small influence in widening and establishing the activities of the Canadian Survey by appearing at the request of John Langton, M. P., before a committee of the Parliament at Quebec in 1854 when the necessity of a palaeontologist for the organization was urgently pressed. Hall and Billings were brothers-in-arms to the end of the present chapter; the shooting did not begin till later.

In February, 1854 Hall received this extraordinary *telegram*:

"Where do you place the division between the Upper Silurian and Devonian among your New York rocks?

W. E. LOGAN "

The reply was not sent by wire; and there was no great hurry about it in view of the fact that the answer has been under discussion for a half cen-

tury since and there doubtless still remains much to be said regarding it. Parts of Hall's long answer however are of much historic interest to students of geology. He said (February 10, 1854):

W. E. Logan Esq.

DEAR SIR * * *

In the first place I do not believe in any marked lines dividing Silurian and Devonian or the so-called Devonian and Carboniferous systems in the United States. If however we are to have a line of separation between Silurian and Devonian we must place it on one side or the other of the *Oriskany sandstone*, and I fear that either horn of this dilemma may be an uncomfortable one.

Have you read my article on the parallelism of the American and European Palaeozoic formations, published in Foster and Whitney's Report? If you have not a copy I will send you one. The paper is rather a rejoinder to what has appeared on the other side of the water.

Perhaps a diagram with some notes may enable you to understand better the state of our knowledge in New York.

Corniferous limestone	}	Upper Helderberg group
Onondaga limestone		
Schoharie grit		
Cauda galli grit	}	Lower Helderberg group
Oriskany sandstone		
Encrinal limestone		
Upper Pentamerus limestone		
Delthyris shaly limestone		
Pentamerus limestone		
Tentaculite or water limestone		
Onondaga salt group		

The Oriskany graduates into the Cauda galli grit which is destitute of fossils and as far as it extends is a non-fossiliferous belt between upper and lower Helderberg Groups.

The Oriskany sandstone contains many peculiar fossils, but a careful comparison shows them to be as nearly related to the lower as the upper forms. In some places the upper member of the Lower Helderberg graduates into the Oriskany which is a chert or hornstone deposit filled with fossils.

In New York the physical line of separation between Lower Helderberg and Oriskany sandstone is very weak and between Oriskany and Upper Helderberg very strong — elsewhere the reverse may be true.

The upward tendency of the Leptaenoid type is the strongest argument for placing Oriskany in the Devonian while I am compelled by other forms to see its close relation with the rocks below.

Our great objection to placing the Oriskany in parallelism with the Devonian of Europe is that below it we have almost no representatives of the Ludlow forms of Murchison, while in the Schoharie grit we have numerous forms of that kind, and *I am quite positive that so long as the Ludlow formations remain included in the Silurian we can never draw any line or separation between Silurian and Devonian that will meet the requirements of the European systematizers.*

This reply perhaps you may think no very definite answer to your inquiry, but, I could not say more definitely in the present state of our knowledge.

I have underscored some lines in the foregoing where still a vital truth lies unconcealed.

During these years the nomenclature of the rocks was the subject of many discussions which were precipitated by the propositions of James D.

Dana, who was not only concerned for his Yale lectures but was preparing his presidential address for the American Association meeting at Providence and at the same time getting in readiness for his "Text-book" which was to come "I suppose within two years," though it did not come till after many.

I give here extracts from a very long letter from Hall to Dana on this theme of nomenclature, a disquisition which covers ten foolscap pages. It was written in reply to Dana's suggestion that the formational divisions should be based on climacteric developments of organic life and the subordinate divisions on localized or subsidiary palaeontology. It will interest students of our science as an illustration of the extremely conservative attitude taken by Hall even to this late date (1855) in the matter of coordination of the American old-rocks with the European and his complete loyalty to the standards which the New York men had so laboriously set up; and I add the comment that more of this conservatism and firm regard for the New York standards would have carried American science into more rational procedures and along a simpler path in the interpretation of our geological history. Hall is writing from Montreal, where he is now spending much time in his work for the Geological Survey of Canada.

MONTREAL, March 5, 1855

[66 years ago]

FRIEND DANA:

[The letter begins with a reference to his Iowa obligations and to the action he is bringing through counsel for the reinstatement of his New York work which he has been carrying along at his own expense. The italics here used are Hall's.]

I will endeavor to reply to some points in your letter in reference to nomenclature. In regard to the Devonian, I will ask, without now refusing to sustain it, why will you sustain a system founded in error [an obviously correct statement so far as this system is based on Sedgwick and Murchison's original account] merely in the first place, it appears to me, for the sake of system-making [or as Professor Schuchert says, to get ahead of the New York men]. I assure you it must turn out that the rocks included in the Devonian of England, with the small exception of the sandstones called "Old Red" in the *Silurian System* will prove of the same age as the Ludlow Rocks of Murchison. And more than this, I believe it is quite impossible for these Ludlow Rocks, in their Modiola-like forms, *Grammysia* and *Nucula* as well as other fossils, to be represented on this continent except in the Hamilton and Chemung rocks of New York; and these we are placing in the Devonian System. Shall we force the name of Devonian System upon a set of rocks here which are so closely simulated by the Ludlow Rocks of England? Why do we not use the term *Palaeozoic* for the whole series, and, leaving out systems, speak of the periods, epochs, groups or rocks as we please, recognizing the true and well determined order in the U. States? [This rational attitude was the direct inheritance from the New York results and geologists today so gladly recognize its competency that they would, in many

cases throw aside the system divisions in the older rocks as an uncomfortable and chafing harness were they not a necessary convenience of expression]. I do not know how far your view of "*strongly-marked centres*" for *geologic* periods will be applicable. If you take the Lower Silurian, for example, as now recognized, you have the Trenton period well marked by fossils. If on the other hand you take the *centre* of the Upper Silurian System you have the Onondaga Salt Group almost without fossils.

I prefer to make the limits where both physical and zoological characters mark the horizon for I am satisfied that it is the natural true view of the matter; and if we neglect the physical features in pursuit wholly of the zoological or vice versa, we shall fail. Physical influences operating from near or remote points have affected the successive faunae of the globe through all time and I hold that we must consider the phenomena of both before we shall arrive at a perfect solution of the difficulties that beset geology. *Zoological progress can not be considered separately from physical revolutions for upon physical revolutions have depended zoological changes and zoological progress.*

If the line now recognized in this country as the base of the Devonian be retained then I see nothing to mark the advent of what is termed *Carboniferous*, a very heterogeneous assemblage of materials as now recognized. I doubt the propriety or authority for carrying reptiles below the Coal measures — the Telerpeton to the contrary notwithstanding; for Mr. Ramsay last year discovered that some of the so-called Old Red Sandstone of Scotland is New Red and I have long suspected, as have others, that much of the poetry of the Old Red was destined to be disturbed by facts.

I would say that the commencement of the Coal period was essentially the beginning, for our continent, of dryland plants and also for air breathing animals, but why should

we admit such an assemblage of marine strata as lie below this into the same System? There may be some convenience in making the four great divisions founded on the four grand classes of animals, as you propose; Molluscs for I Silurian; Fishes for II Devonian; Saurians for III Carboniferous and Jurassic, and Mammalia for IV Tertiary. We have birds as well in the Jurassic and no Saurians in the Lower Carboniferous while Silurian, Devonian and Lower Carboniferous are more intimately united both physically and zoologically than, by any possibility can be the Carboniferous and Jurassic.

In relation to Cambrian, the limits claimed by Sedgwick include all the large cephalopods of the Orthoceratite family. If you admit that there are species and genera peculiar to the Cambrian, or admit it at all, it must be admitted in full and it is as fully entitled to rank as a System as the Silurian. Murchison in the outset committed a gross blunder in mingling (for nature had not done it for him) the Lower Silurian (Cambrian) with Upper Silurian forms and, by thus disguising or misrepresenting Nature, closed the eyes of observers to the very strong line of demarcation between the Lower Silurian and the Upper, a line always to be recognized the world over and far more definite than any ever proposed between the Silurian and Devonian and between the Devonian and Carboniferous. If Fishes are to characterize the Devonian then you should unite with that System the Carboniferous limestones which contain abundance of fishes and no Saurians.

I agree precisely with your view in relation to the Potsdam and Calciferous. I have some doubt about uniting Chazy, Birdseye, Black River and Trenton in one period, and yet I believe it is inevitable, though in many places the Chazy seems more intimately connected with the Calciferous. The investigations of the fossils of Canada will determine

that point. The Utica slate and Hudson River are one and should be the

Hudson River	}	Shales and sandstones and Salmon River ; Vanuxem
Fauna		Frankfort slate
		Utica slate

Again through the organic forms, the Hudson River is closely allied to the Trenton and other limestones and yet the line of separation is easily traced to the Mississippi and beyond it. A considerable number of species characterize the Blue limestone of the west, that never occur in the Trenton limestones below, or in the Hudson River Group at the east, though the physical conditions of the two groups are more similar at the west than they are in the east.

We may substitute Shawangunk for Oneida. It is a great pity that the few feet of conglomerate there shown shall be cited while the magnificent exhibition in the Shawangunk is subordinate. The Shawangunk and Blue or Kittatinny mountain to the S. W. and in the same range northeast to Canada mark the great development of this rock.

Your views in regard to the Niagara period and subordinate epochs I consider just. The Onondaga Salt Group is a distinct period. The Lower Helderberg does not always present the well defined epochs of the Niagara period. They correspond more nearly to the subdivisions of the Clinton Group, though more constant, and perhaps they should be considered as epochs, subordinate as I have treated them in my third volume, to the Lower Helderberg, but recognizing them by their fossils when possible.

	Epoch	Subepoch
The Upper Helderberg Period	_____?	Corniferous
	_____?	Onondaga
	Schoharie grit	

The Onondaga and Corniferous are too often blended to render the distinction valuable over large areas, at least that has been my experience. I would agree that the Hamilton period should include Marcellus shale as one epoch, Hamilton as second (Tully limestone ?), Genesee slate third.

Chemung period including Portage and Chemung epochs — with several subepochs.

The Catskill period — with subdivisions yet to be made.

* * *

In reference to the Taconic System generally I would call your attention to my remarks at New Haven in 1855 and to a more full paper at the meeting of Association in New York in 1856 for the first exposition and refutation of the existence of a Taconic System. You may recollect also that I sent a review to the Journal which was returned to me as being too *spicy* or too personal. I have it yet and as the Taconic System now and then shows a sign of life I may as well claim that I have the honor (?) of first refuting it by a series of carefully made sections across the Green mountain range, showing in fact all that has since been shown of the age of these altered limestones, slates and other rocks.

I call your attention to this as it may be necessary to reclaim this at some future time, since the Taconic System is likely again to appear, on paper, in full force in Emmons's Report on N. Carolina.

I must conclude in haste

I am yours truly,

JAMES HALL

And to enliven this sober chapter, this seems to be the place to tell the story of the fatal \$400 which Hall had borrowed from Emmons while hard pressed at the Rensselaer School. I had it from Ebenezer Emmons, Jr. The

note had been renewed again and again and still in these bitter Taconic years remained unpaid. Emmons finally determined to sue it. Hall alarmed and annoyed repaired to Emmons's house and rang the door bell which was answered by Ebenezer. "I want to see your father, Eb., about that note of mine". "Father says he won't see you, Hall. You have treated him too badly about his Taconic System". "Eb., I know your father has some right to what he claims but you tell him I'll never admit it if he sues that note!".

3

Hall's zenith — President of the American Association for the Advancement of Science — Albany meeting, 1856 — Dedication of Geological Hall and Dudley Observatory — Distinguished occasion — Public tributes to Hall and his work — Montreal meeting, 1857 — Death of Professor J. W. Bailey — Hall's impressive presidential address on mountain making — Effect on his hearers — Joseph Henry's inquiry and Hall's reply — Letter to Sterry Hunt — Modern views of Hall's theories — James Geikie's analysis — E. Haug's *Loi de James Hall* — Publication of *Palaeontology III* — Its content, quality and manner of making — A triumph of research — The Baltimore meeting of the American Association and the Permian tempest — Friends and admirers; honors and awards.

TO every devoted servant of Science there comes a zenithal day when in the midst of his labors, he is halted to receive the acclaim of his fellows. For Professor Hall this event came with the meeting of the American Association for the Advancement of Science in Albany in 1856. It was no ordinary occasion; indeed, it proved a momentous event for science in New York; and it is not to be forgotten among the influential episodes in the history of that great society.

At the Providence meeting of the year before, where Dana had given his presidential address,¹ Hall was chosen his successor in office, and through the invitation of the citizens of Albany presented in person at Providence by Dr. James H. Armsby, the Association had agreed upon Hall's home town as the place of its meeting during his presidency.

Since the Albany meeting of 1851, which had been brought on to help forward the Albany University, interest in science at the seat of government had shown itself in various ways. With the support of the Governor of the State, Myron H. Clark, provision had been made for remaking the "Old State Hall" on State street into a building suitable for the growing collections of the "State Cabinet" and the offices of the curator, with an auditorium for public lectures. This building was to be known as the "Geological Hall." It was now hurried to its completion, its auditorium was to be the general meeting place of the Association and its public dedication to scientific purposes was set

¹From Dana to Hall:

December 26, 1854

"I think it probable that if I deliver any address at the next [Providence] meeting of the Association, which is quite doubtful, my subject will be: The Progress of Geology Through American Observations. I should endeavor to refer impartially steps of progress to those who made them. I shall ask your opinion of what I may write. Geology is almost the only science in which progress has been made in the country except some departments of zoology. Chemistry has done almost nothing independent of analyses of minerals; physics not much of late years."



JAMES HALL

President, American Association for the Advancement of Science
1856

(Lithograph by Swinton)



for the occasion of this assembly. The Dudley Observatory, the finest flower of the extinguished University, then crowning with unfinished buildings the crest of the hill near the home of the Patroon, the Van Rensselaer Manor, was also to be dedicated with great circumstance on the same occasion. It is needless to say that such a combination of distinguished events brought together a great body of devotees in all walks of science and to that day no such notable scientific assemblage had gathered on American soil. The "local committee," on whom responsibilities for entertainment on this occasion devolved, were competent to their task: Gerrit Y. Lansing, Chancellor of the University, was the chairman, and of its members were Governor Clark, John V. L. Pruyn, a future Chancellor, Thurlow Weed, Amos Dean, Thomas W. Olcott, Ezra P. Prentice, Stephen Van Rensselaer, Dr. Thomas Hun, Gideon Hawley, Justice Amasa J. Parker—names still distinguished after more than a half century. These men went far. They sent out invitations to a large number of European men of science and persuaded the owners of ocean stemers, among them Edward Cunard of the Cunard Line, and directors of several other steamship companies to offer free transportation to these foreign guests. Special provision was made for the visit of Liebig, the great chemist, though he failed to

come. They went further; their emissaries went to Europe to present in person these invitations. Elaborate receptions were planned and given to the members and visitors by the Patroon Mr. Van Rensselaer, the stately Mr. Pruyn, Mrs. Blandina Dudley the founder of the Observatory, and several others. A brilliant marquee carrying the legends of all the sciences was erected in the park in front of the Albany Academy, the place of Joseph Henry's early discoveries, and under it on a glowing August afternoon, dispersed among the shades of the neighboring elms, gathered the scientific throng for these dedicatory exercises.

On the raised seats were the Governor of the State, Myron H. Clark, with Millard Fillmore and former Governor Hunt; with Henry, Silliman, Bache, Mitchell, Agassiz and Hall; Sir William Logan and President Hitchcock; Chancellor Walworth and Bishop Potter; and in a scholarly and dignified address of two hours' duration, Edward Everett, former Governor of Massachusetts, and then United States Senator, consecrated the new Observatory.

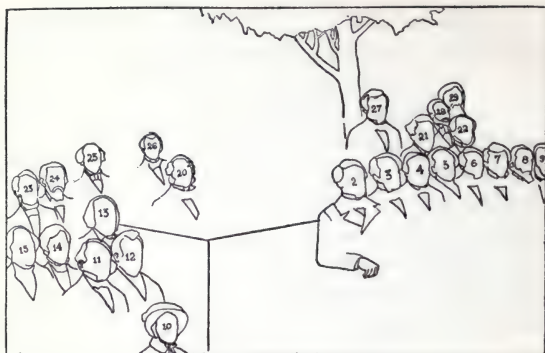
Under the same canvas, the dedication of the Geological Hall preceded this function and it was the occasion of unstinted tributes from Mr. Hall's most intimate and eminent associates. No formal address was made but one after another poured a libation to his successful work. Professor Agassiz



Dedication of the Dudley Observatory and Geological Hall
(From the painting by Tompkins H. Matteson; in possession of the Albany Institute)

said, speaking first: "The Geological Survey of New York has given a new nomenclature to science. Hereafter no geologist can venture to bring his theories before the world unless he first consult its beautiful volumes. When European men of science come to this country their first question is: 'Which way is Albany?'" President Edward Hitchcock of Amherst, in the course of his laudatory remarks, recalled the fact "that the first instance of a Geological Survey in this State or in the Union was set on foot by that patriotic and noble citizen Stephen Van Rensselaer, nearly fifty years ago." Sir William Logan declared that the Geological Survey of New York had stimulated Canada to undertake a similar service. "When I came from England" he said, I was one of those who asked: 'Which is the way for Albany?', and I took up the work where New York left it at its boundaries and carried it forward." He was followed by the venerable Professors Silliman and Chester Dewey; and to all this flood of tribute Hall was not permitted to respond.

Throughout the entire week of the sessions of the Association, Professor Hall was its central figure, conspicuous by the necessity of his office. And when they came to go, Dr. Steiner of Baltimore, in moving adjournment, declared that when some future palaeontologist should find him turned to adipocere he would behold graven on his heart



KEY TO PLATE

- 2 Prof. Joseph Henry, Secretary, Smithsonian Institution
- 3 Prof. Benjamin Silliman, Yale University
- 4 Dr. Thomas Hun, Albany
- 5 Rev. Dr. Eben Halley, Albany
- 6 President Edward Hitchcock, Amherst
- 7 William B. Rogers, State Geologist, Pennsylvania
- 8
- 9 Henry R. Schoolcraft, Washington
- 10 Mrs. Blandina Dudley, Albany
- 11 Thomas Olcott, Albany
- 12 Chancellor Gerrit Y. Lansing, Albany
- 13 Gideon Hawley, Regent at Large, Smithsonian Institution
- 14 Ezra P. Prentice, Albany
- 15 Rev. Dr. William B. Sprague, Albany
- 20 Sir William Logan, Montreal
- 21 Orlando Meads, Albany
- 22 Dr. Philip Ten Eyck, Albany
- 23 Alexander D. Bache, Sup't. U. S. Coast Survey
- 24 Prof. Benjamin A. Gould, Director, Dudley Observatory
- 25 Hon. Horatio Seymour, Ex-Governor of New York
- 26 General Peter Gansevoort, Albany
- 27 Hon. John V. L. Pruyn, Albany
- 28 Martin B. Anderson, President, University of Rochester
- 29 Prof. Benjamin Peirce, Harvard College



Dedication of the Dudley Observatory and Geological Hall
(See next page for key to names)



the word "Albany;" whereat Agassiz in joining the motion added: "and with his eyeballs turned inward in adoring memory."

The meeting over and many important discussions held, a very positive impulse had been given to American science and the reaction upon Professor Hall was to confirm him among his own people. Soon Dana writes (September 5, 1856):

DEAR HALL:

I feel anxious to know how you are after the long siege of the Association, for you each day seemed hardly strong enough for its duties and I have feared that when the pressure was finally off you might have a relapse. I shall be gratified to learn that you are gaining in strength and health. It was a magnificent meeting and it must be a source of special pleasure to you that this best of all our meetings was under your presidency and too, in your city. Albany did nobly indeed. I shall ever remember the untiring efforts of Doctor Armsby, Mr. Gavit and Mr. Woolworth and the kindness and liberality of very many others among the citizens.

The Montreal Address

In 1857 the meeting was at Montreal under the auspices of Sir William Logan. Professor Jacob W. Bailey of the West Point Military Academy, the most distinguished American student of microscopic palaeontology, had been elected president, but he had died in the interval.²

² Jacob W. Bailey entered the West Point Military Academy at the age of 17 and was at the time of his death Professor of Chemistry, Mineralogy and Geology in that institution. His wife and



KEY TO PLATE

- 1 Hon. Edward Everett, U. S. Senator
- 30 Dr. James MacNaughton, Albany
- 31 Governor Myron H. Clark
- 32 Ex-Gov. Washington Hunt
- 33 Dr. Alfred L. Loomis, New York
- 34 Victor M. Rice, Sup't. Public Instruction
- 35 Prof. Louis Agassiz, Cambridge
- 36 Dr. Ebenezer Emmons, Albany
- 37 Prof. James D. Dana, New Haven
- 38 Prof. James Hall, Albany
- 39 W. C. Redfield, 1st President, A.A.A.S.
- 40 Prof. Samuel H. Hammond
- 41 Prof. Charles Davies, U. S. Military Academy
- 42 B. P. Johnson, President, State Agricultural Society
- 43 Prof. Dr. James H. Armsby, Albany
- 44 Hon. Ira Harris, Albany
- 45 Hon. Amasa J. Parker, Albany
- 46 Amos Dean, LL.D., Albany
- 47 Hon. Robert H. Pruyn, Albany



Dedication of the Dudley Observatory and Geological Hall
(See next page for key to names)

This meeting at Montreal was the occasion of Hall's most notable performance in philosophical geology, embodied in his address as retiring president. Under the title "Geological History of the North American Continent," President Hall undertook an exposition of the procedure of mountain making and continental uplift which bore not only the evidence of profound reasoning based on broad experience but had all the exciting interest of novelty. It was a carefully thought out course of argument, but obviously Hall presented it with tentative caution and some degree of timidity, at all events with entire absence of finality; for he would not permit its publication in the usual way in the next year's volume of the Association's proceedings. In fact it was not printed by the Association for more than twenty-five years (1883); but it was printed, we presume, essentially as delivered, in the Introduction to his *Palaeontology* III. In this essay Hall set forth two essential propositions:

1. That ranges of folded mountains exist only where sediments have uniformly accumulated to

daughter perished by the burning of the steamer *Henry Clay* on the Hudson River in 1852, the same accident that resulted in the death of Andrew J. Downing. Professor Bailey died in his 46th year leaving behind him a son who has become a distinguished ornament of the science of geology and who, now in his 82nd year, has borne for more than a generation the title of Provincial Geologist of New Brunswick; Loring W. Bailey, LL.D., Fredericton, N. B.

maximum thickness and that such maximum accumulation is possible only by corresponding depression of the sea bottom along the edges of continents delivering such sediments. In this conception of crustal downfoldings, afterward called *geosynclines* by Dana, was involved the idea of extended lineaments or directrices of continental structures. The other fundamental proposition was

2. That folded mountains result from the crumpling of the upper layers only of these accumulated deposits, a consequence of the adjustment of the later sediments to a deepening but contracting depression.

Incidentally he established a geodetic principle then undefined, but having to do with compensatory movements of the earth's crust; the necessary uprising of the continental plateau in response to the downward movement of the geosyncline; *isotasy*, as it is now termed; and inferentially accounted for, though not in accordance with present notions, the variant attitudes of the strata within the crustal depression; disconformities and minor unconformities. According to these ideas, areas of maximum accumulation were uplifted to the continental plateau and bore axial mountain ranges, which were folded not of necessity, as the Catskill mesa indicated, but only in cases where a narrowing trough compelled.

The author was able to fortify his themes with a greater wealth of evidence than any one else could muster from the rocks of America and from an intimate knowledge of Appalachian structures throughout this range of folded mountains; and though he conceded that his suggestions regarding terrestrial equilibrium may have been intimated in remote connection by Babbage and Herschel, he insisted that his arguments were derived from data wholly unlike theirs.

Hall's thesis was quickly attacked. It was pointed out that his troughs of depression were scores of times as wide as deep, and were in fact like mere scratches on the crust, and Dana told him he had developed a fine theory of mountain making but had left the mountains out.

The geologists went away from Montreal shaking their heads, and soon Professor Joseph Henry wrote anxiously but in a most friendly spirit asking for some light on these new ideas:

"I should be pleased to have an opportunity to discuss with you your new views of geology. They are, as I understood them from your remarks at Montreal, of such a remarkable character that did they not come from you I would suppose there would be nothing in them. Your opinions are however entitled to my attention and respect though they may be considered at variance with what have long been regarded established principles. If after having brought your views to the test of the widest collection of facts you still are assured they are correct, then give them

to the world, but I beg that you will be cautious and not commit yourself prematurely.

Forgive the freedom of my remarks — they are dictated by a regard for your reputation which belongs to the science of the country and is now powerful in the advance of truth or in the propagation of error.

I remain very truly your friend

JOSEPH HENRY

The answer to this request is, perhaps, the simplest presentation that can be given of this important matter, for it was addressed to a man who was not a geologist.

Professor JOSEPH HENRY

Smithsonian Institution ALBANY, *December 26, 1857.*

MY DEAR SIR:

I very much regret that it has not been in my power to discuss fully with you the points which I have brought forward in my address, and which appear to some of my friends so strange as to hazard, or rather as the expression is, to "compromise" my scientific reputation. I agree with you that no one should advance new views or theories till well considered, and I should be extremely sorry to advance anything which was not founded on the manifestations of Nature. I can say that thus far I have exercised the most scrupulous care that all I have advanced should bear the test of the most careful reexamination — and I would sooner commit a moral falsehood than a scientific one, if I could deliberately do either.

My views are the most simple and natural conclusions from the observed facts, and so simple that I am surprised that the same idea should not have occurred to every

observer. In the first place geological accumulations are spread over an ocean bed; towards the source of this material and along the line of the stronger current there will be the greatest accumulation. It is quite impossible from the nature of the material and of the forces in operation that you can have deposits of uniform thickness over wide areas. The lines of greatest accumulation have been necessarily the lines or areas of subsidence, for the sea has not been deep originally, but the bed has gradually subsided to admit the accumulation of thousands of feet. Simple subsidence of the crust may account for the plications of the formation. When these accumulations subsequently emerge, it is or has been on this continent a continental emergence, and not an emergence along certain lines of fracture or uplifting, as we have been taught to believe. If we take as an example the Appalachian chain, we find that it is composed of numerous parallel ranges, as has been well shown by Rogers and others, but the greatest height of the mountain chain scarcely exceeds half of the original thickness of the deposits of which they are composed. The highest rock of the Green mountains, say 4000 feet above tide water, is the upper member of the Hudson river group; now the entire thickness of the sediment, from the base of the Potsdam to the top of the Hudson river is scarcely less than 10,000 feet. You will see that there is much below the sea level as there is above it, and this I believe to be true in all similar mountain chains. It is not therefore the elevation or uplifting, if you please to call it so, that has given geographical height, but the original thickness of the deposit, and no disturbance or uplifting of strata, that is uplifting of beds, can ever give you as great an elevation as the original pile in its horizontal and unaltered condition. As an example we have the Catskill Mts., nearly 4000 feet above the level of the sea, composed of nearly horizontal beds, while on the east side of the Hud-

son the disturbed region consisting of Lower Silurian formations altogether at least 10,000 feet in thickness give no mountains of 4,000 feet high. There is another point for consideration also. All theoretical sections give you the elevation, as if produced by the bulging up of the granite or some part of the central primary nucleus; on the contrary nearly all worked or actual sections show nothing of this or only insignificant effects from some local outbreak of volcanic matter. Geologists are pretty well agreed to abandon the term *primary*, but they have not at the same time dropped the theoretical views connected with it and we still reason as if we had proved the existence of an unstratified primary mass, which in truth exists in theory only; though doubtless existing, it nowhere comes to the surface. The foldings and plications of strata which give elevation seem generally to involve nothing beyond that set of strata, as may be shown in numerous sections made in this country and in Europe. Nor do elevations thus produced remain elevations, for so soon as strata are bent upwards they are weakened by cracks & otherwise, and subjected to erosion, so that we never or almost never find the exhibition which we might suppose would result from a folding and plication of the strata. If we show a set of strata thus wrinkled, we shall find that the anticlinal axes are all eroded so that instead of being mountains, these parts are really valleys, while the original valley, the synclinal, is the mountain, the erosion having gone on so as to remove all that part above the red lines, while the line of sea level is about midway between the base and top of the group of beds; or there may be often a much larger proportion of the material beneath the sea level. If you will examine some sections in the first volume of the *Memoirs of the Geol. Survey of Great Britain* you will see the representation of the amount which has been eroded, the proportion above the

sea level and that below. Had these beds continued unbroken, we should have had high hills where there are now valleys. The valleys are lines of greater disturbance, while the mountains and higher grounds are those parts where there has been least disturbance. See also, if you will, any set of really worked geological sections and you will find essentially these features.

As to another important phase of his propositions, that of attendant secondary change or metamorphism, he writes to his friend Sterry Hunt (October 10, 1858):

“In reference to my views in connection with this matter of mountains I have distinctly said in my Montreal address that these lines of accumulation and metamorphism are coincident; that the line of the Appalachian chain is likewise the line of metamorphic action and effects of that action become less and less visible as you recede, etc., not from any primary or incandescent nucleus, but as you recede from the line of greatest accumulation of sediments and as the accumulated beds become thinner, the evidence of metamorphic action becomes less and less apparent. I have cited moreover the axes along the Mississippi valley where the strata are thin, showing they neither produce mountain elevations nor are they metamorphic, though often tilted at angles equal to the inclined strata on the flanks of the Appalachian chain. It seems to me very clear that there can be no metamorphism affecting any considerable extent, without previous accumulation.”

Twenty years elapsed, and in the light of later knowledge he writes to Clarence King, director of the new United States Geological Survey, who had

asked if he still held to his explanation (Jan. 10, 1876):

"In relation to my views of mountain-building, I do not know that they have undergone any material change. I cannot believe that mountain ranges exist without, in the first place, *accumulation* of sediments—which must be along coast lines or current lines—or perhaps I should not take it for granted that you believe all our formations of sedimentary origin. But when our oldest Laurentian granites show that they were originally conglomerates, and that the pebbles of these conglomerates are *stratified* or *laminated* rock, it is going a long way back with sedimentation.

Then we know that these accumulations did not always take place in a deep sea, for in the semi-metamorphic rocks we have ripple marks, fucojds and mud cracks at various depths through 20,000 feet of thickness. I believe therefore that these great accumulations produced a depression of the crust. I do not intend to ignore contraction from cooling but really this seemed to me to be recognized as an elementary principle and it did not occur to me at the time to use the arguments. I believe you can have no great amount of depression without producing numerous minor foldings as you may see within every synclinal fold in a gneiss rock.

Mountains are not elevated as ranges of mountains, but as part of the continental movement. Erosion has taken place along the weakest lines, the anticlinals. The synclinals have been protected and remain as the final results.

I was led to this conclusion by a study of the New England ranges, the Adirondacks (Laurentian) and the Appalachian as far south as Virginia—and a comparison with the thinning expansions of the same formations in the west. I have seen too little of the Rocky Mts. to be entitled to an

opinion, but at a point known as Bear Mountain, I believe, forty miles west of Laramie, and where the snow remains till August, I found the mountain mass regularly stratified and dipping to the westward away from the eastern escarpment.

I can only say therefore that I have seen nothing to change in any material degree my general views of mountain building. Were I to review and rewrite my views I might present some points more clearly, but the hoped for time has not yet come to me, and I must trust to you and to others to interpret with what limits you will, the expression of views based perhaps upon too limited an observation and acquired amid the more serious labor of tracing out and identifying by their fossil contents the widespread palaeozoic formations of the United States on the east of the Mississippi River."

The years have run on; it is interesting to inquire where now those virgin ideas stand in the science today, I quote first from James Geikie, the distinguished Scotch geologist, in his *Mountains; Their Origin, Growth and Decay* (Edinburgh 1913, p. 199):

"James Hall, a well known American geologist, appears to have been the first to formulate the opinion that a deep trough or basin of depression has in all cases preceded the process of mountain making. In his view, therefore, the materials of which our folded mountains have been constructed were slowly accumulated in elongated depressions of the crust. The strata thus accumulated are chiefly or exclusively marine and for the most part appear to be of shallow water origin. They are comparable, in short, to the sediments now gathering off continental coasts at no great

distance from the land. An immense succession of strata composed of such material obviously must have been deposited upon a gradually sinking sea-floor. It would seem therefore that there must be a causal connection between crustal subsidence and sedimentation; either subsidence is the cause of continuous accumulation or the crust must sag under a gradually growing weight of sediment."

On the basis of Herschel's earlier suggestions regarding compensatory down and up movements of the crust, "the removal of the rock material from the land" says Geikie, "would cause the latter to rise while the adjacent sea-floor, weighted with the transported material, would tend to sink. James Hall extended this view to explain the origin of the Appalachian mountains and similar ranges, maintaining that great troughs or basins were caused by the gradual sagging of the sea-floor under a constantly increasing load of sediment."

And after speaking of the objections to the theory raised by contemporary writers, to which we have already referred, Geikie proceeds:

"Hall was aware that his theory, while it accounted as he thought for the folding of the strata, left the elevation of the mountains unexplained. It became necessary, therefore, to postulate another crustal movement and to suppose that after the folding of the strata had been completed, the whole region was uplifted so as to form a wide plateau out of which the existing ranges and valleys were subsequently carved by erosion. Other objections have been urged to James Hall's theory of the origin of mountains, but as it no longer finds supporters we may leave it here."

"One of his doctrines however," the author immediately adds, "has gained considerable acceptance, the doctrine, namely that denudation induces elevation of the land while concurrent sedimentation causes the sea-floor to sink." After a close analysis of this proposition which seems to ignore the isostatic element embodied in it, Geikie concludes (p. 210) with a general endorsement of the interpretation, probably originating with Dana and now accepted by Suess and Schuchert, that such depressions are due to the progressive shrinking of the earth's volume.

That is one expert opinion. We may now look to a quite different exegesis of Hall's views. Haug, the eminent French geologist, in his *Traité de Gèologie* (1907, p. 159), after referring to Hall's gravitational interpretation and to Dana's introduction of the term *geosyncline* for a depression caused not by sagging under accumulating weight but by radial compression, proceeds to say:

"It is evident that the formation of a geosyncline can not be directly observed, but one must infer its existence wherever it is possible to determine an elongated zone on the surface of the globe which is characterized by a considerable thickness of sediments belonging to a definite geological period and which is bordered, in part or otherwise, by regions where the sediments attain a very much reduced thickness. Usually the beds of a geosyncline are of deep water origin while the lateral beds are of shallow water. But this is not an invariable rule." "To James Hall we owe another deter-

mination which has become the basis of modern orogenic theories. This author has shown that the position of the folded regions of the earth coincide with zones of greatest sedimentation. Today we give this *law* the following expression: *Mountain chains are formed on geosynclines.*" "The most remarkable verification of *James Hall's Law* [loi de James Hall]; is furnished by the zone of Alpine folds."

and the author proceeds to abundantly elaborate the illustrations of this law of folded mountains.

With these opposing conclusions as to the perpetuity of Hall's argumentation we may rest this theme. His Montreal address is still a monument to his sagacity.

With the closing of the busy decade came its cap-sheaf and crown, the publication of Palaeontology III, a work which, I think, is to be rated the finest in quality of research as it was the most impressive in size, of all its author's productions to this time. The imposing monograph in two quarto volumes was entitled "Palaeontology Volume III, Containing Descriptions and Figures of the Organic Remains of the Lower Helderberg Group and the Oriskany Sandstone"; its first volume was a text bearing the date 1859 and carrying 556 pages, while the second (1861) contained 142 plates of beautiful drawings by Meek and Whitfield, exquisitely lithographed by Swinton and together constituting a great advance in finish and accuracy of detail over the previous volumes and

the finest illustrations of such objects that had yet been made in America. These volumes included in the Introduction the notable essay just referred to expanded with vast detail to a length of 92 quarto pages. The work had been prepared amid all sorts of distractions and interruptions; but in all the many excursions of its author into other issues he never lost sight or hold of his main enterprise. Herein he brought together an extraordinary wealth of ancient life from the Helderberg formations whose profusely loaded sediments lay best developed in the hills about Albany; and from the rich sands of the Oriskany formation which stretch across New York in broad outcropping lenses; and in these two volumes he depicted a wondrous panorama of life. A singular interest was given to these works by the fact that even at this time Hall was not willing to say positively whether these formations were to be interpreted as appertaining to the Silurian or to the Devonian System. On this proposition he would not commit himself, in his profounder wisdom still seeing in them conjoint members of the New York System of Formations with which other systems might, were it desirable or worth while, be coordinated. He recognized the arguments first advanced by DeVerneuil for regarding the Oriskany as the opening member of the Devonian System, and he was fully alive, as no other was, to the mixture of

Silurian and Devonian elements in the Lower Helderberg limestones;³ but his indifference to such correlations is noticeable and Murchison's dogmatic terms were still obviously distasteful to him; they were of minor importance in the presence of New York terms much better defined in their limits and vastly better known as to contents.

Among the particularly fine parts of this book was the brilliant analysis given of those extraordinary creatures of the Waterlime series (now recognized under the name Bertie waterlime as the latest life term of the Silurian System), the Eurypterida, lobster-like ancestors of the scorpions and spiders and the most highly organized creatures of the then known world, but whose relations with the life of today was yet buried in mystery. They were classic objects in the old rocks of Britain where the Scotch quarrymen called their broad flat bodies "seraphim" and the Scotch stone-mason Hugh Miller described them. The New York development of these creatures in the

³ In present interpretation both of these faunas are included in the Devonian System as its basal elements. When the writer seriously brought forward for the first time in America the predominating Devonian characters of the Helderberg fauna, basing his inferences of this age not on percentages of species common to the Helderberg and to the Devonian, but on the introduction into the earlier fauna, of a series of definitely Devonian biological types, Hall complacently remarked, "You are walking a tight-rope; if your balancing pole drops down on one side, your body must lean the other way."

vicinity of Buffalo and the region south of Utica was very striking and the later years have shown an increasingly vast and varied assortment of them from east to west in the State, more than in all the world beside. Hall's account of these creatures was the first really exact and conclusively analytical study of their morphology and to incorporate his account of them in this book he held up the presses after all the pages were numbered and inserted both pages and plates after the book was really done.

Palaeontology III is a great panel-stone in its author's monument. Let me make further reference only to these details: Colonel Jewett and Ledyard Lincklaen were busily engaged in Central New York collecting fossils for use in this volume, and one day in 1853 Colonel Jewett writes to tell Hall that he has found in Litchfield a crinoid which "I venture to say is the finest ever seen by man." Soon after, another of this marvelous sort was found by Mr. Lincklaen; and both may be found illustrated in the volume under the name *Mariacrinus nobilissimus*. They were indeed the most imposing and beautiful of the stone-lilies which the New York rocks had then produced, and Agassiz, to whom Hall sent one of the specimens, exclaimed with his characteristic enthusiasm: "It is the most wonderful thing I ever saw." Deeply impressed and in a spirit of reverent hom-

age Hall named the graceful creature for her to whom he would pay highest honor — the Holy Virgin, the Spirit of the Sea.

Again Hall stopped the printing of his book to make room for a new and important addition — the outcome of an unlooked for and remote incident. In 1853 he happened to receive from Mr. William A. Thomas of Irvington, N. Y., a letter requesting him to identify a certain oyster shell that had come to him from the Choctaw country. This led to fresh correspondence, suggestions of exchange and finally to information about some interesting fossils which were being brought together by Mr. Thomas's acquaintance, William A. Andrews of Cumberland, Maryland. The correspondence opened the door for Hall to the beautiful Cumberland Oriskany fossils which, by grace of Mr. Andrews, Hall added to his book, after, as we have said, this book was practically printed. Hall was ever a costly maker of books. He never hesitated to destroy an expensive lithograph plate even after the edition was printed off, in case it seemed to him inaccurate or unlovely; and the profusion of his illustrations was more than once the basis of legislative inquiry. He printed advance editions, fascicles and post-editions of parts of his books regardless of contracts and he made and paid for untold hundreds of

drawings in expectation of use, many of which remain unpublished to this day.

Troubles with the Permian

When the Baltimore meeting of the American Association (1858) was breaking up, Hall was heard to speak somewhat explosively of palaeontology as the "science of dead rabbits" — an expression which he had picked up from some legislative committee in Albany. In the meeting the younger men had been giving him a bad and rather unfair quarter-hour over the matter of the discovery of the Permian System in America. The story of this curious little tempest ran in this wise:

In 1856 or '57, Major Frederick Hawn, working as a surveyor in Kansas, had found Permian fossils though without knowing their age, and he sent the part he thought to be Cretaceous on to Meek who then, with Hayden, was at Albany working in Hall's office. Meek cleverly recognized their import and, jointly with Dr. Hayden, who had found similar fossils in Nebraska though without recognizing their age, prepared an account of them and with Hall's help, got this account before the Albany Institute early in March, 1858. To Swallow, his personal friend, Major Hawn had sent another series of these rocks, and with the

hint of the presence of the Permian, Swallow came before the St. Louis Academy with his account of the species two weeks earlier than Meek and Hayden. By the second week in March, B. F. Shumard had brought before the same Academy, notice of Permian fossils from the Guadalupe mountains in New Mexico, and by another month Dr. Norwood had reported them from Illinois. It was these Illinois Permian fossils that made the present trouble. Hall was just then writing his "Geology of Iowa" and in this volume which bears the imprint of 1858, he speaks of "some peculiar fossils collected several years since in Illinois," placed in his hands in the early part of 1857 by Mr. Worthen, of which he says that an "examination proves them to be of Permian types." In a foot-note Mr. Hall made reference to the announcements mentioned above, but he had himself thus announced a still earlier discovery of the Permian though it can not be said that he recognized the fossils as such until these suggestions came to him from outside. It is all a curious illustration of how scientific discovery of an important fact often comes about as a synchronous climax of variously directed efforts. It has often happened and doubtless often will happen when intellectual efforts of several individuals are centered, perhaps even unconsciously, upon one objective. The question which now arose in the Balti-

more meeting was: Who discovered the Permian in North America? Hawn discovered the material; Swallow was the first to give an account of it, while Meek was the first to recognize its significance, and Hall, coming last, was the man who apparently attempted to antedate the whole procedure. It appears from some interchange of letters between Hall and Joseph Henry, that the young men had a merry time with Hall over this matter and shortly afterwards, in writing to Professor Andrew C. Ramsay of the British Survey, Hall begs him not to mention his name in connection with the Permian in America, for he had "resolved to expunge the word Permian from the Iowa report", though he did not do it, for his book was already nearly printed; but in his dedication to Governor Lowe which was written in September 1858, he straightened the matter out and washed his hands of the Permian forever thereafter.

The letter here attached, from Professor G. C. Swallow, is of interest in this connection:

COLUMBIA, MO., *Dec. 6, 1858.*

As to Mr. Hawn; I feel that he is entitled to much consideration from the Government and from scientific men. He has made all his explorations, as I understand it, at his own expense, although a poor man, dependent upon his labor for the support of his family. He spent one winter in central Kansas surrounded by the snows, savages and savage beasts and has spent much of his time during the past three

years and considerable money in bringing out the geology of Kansas. It is through him that we know the existence and extent of the vast gypsum beds in central Kansas. This and nothing else will enable the Government to sell vast areas of the sandy plains of central Kansas and if the Government aids anyone in making explorations in those regions it seems but just that Major Hawn should have such aid.

General Calhoun, through my suggestion and the advice of friends, made application for means to prosecute those geological explorations commenced so successfully by Major Hawn but did not succeed in obtaining it. Still Major Hawn is making further explorations this season while making linear surveys for the Government. I know of no one in our country who has labored with more zeal and success and at the same time paid all expenses from his own pocket. Major Hawn is the father of the Kansas Permian so far as the hard labor to bring out the effect pertains.

Miscellanies

To this picture of Hall's activities there are many touches during this period, some of light and some of shadow, which should be added to make the perspective true. Perhaps among these the most pleasing are the evidences of loyalty and regard from those who were watching his career. Among these admirers was General F. E. Spinner, Treasurer of the United States for so long that his impressive non-counterfeitable signature on the treasury notes is still a thing of pleasant memory. Professor James Woodrow of Oglethorpe University, Talmage, Georgia, who signs himself

“Your Fellow Lover of Science”; destined by the stars to become the maternal uncle of the War President who once characterized Science as “an ascetic nun,” and afterwards fortified her monastic modes by authorizing the establishment of the National Research Council; begs Hall’s advice in directing his career of scientific study in Europe.

A letter of 1853 introduces to Professor Hall, Henry A. Ward, of Geneseo, “a young enthusiast in those sciences which you have elevated so much by your indefatigable labors,” and begs that he “will bestow upon him a portion of that personal interest in his hitherto unusually successful efforts for scientific *acquisition* which is so much valued by us for its generous encouragement.” Hall received young Ward warmly, sent him to Agassiz at Cambridge where soon he is “devoting my whole time to zoology,” and late in 1854 he writes from Paris that he has been “enabled through the generosity of my patron Hon. James Wadsworth of Geneseo to cross the Atlantic and pursue my scientific studies” there. He was hearing lectures in the Jardin des Plantes and the Ecole des Mines and already planning trips to Italy and Egypt to indulge that extraordinary acquisitiveness for all objects of science which laid the foundations of the now historic Natural Science Establishment at Rochester, N. Y., out of which have graduated Grove K. Gilbert, Edwin W. Howell, William T.

Hornaday, Frederic A. Lucas, generations of Wards and a score of other well trained scientific men.

Professor Horsford writes from his fireside at Cambridge on a winter's night in 1856:

"I was forcibly reminded of you last evening in looking over a pile of letters of former dates and particularly of the period of my application for the chair here. I was committing letter after letter to the flames, feeling that my study was getting too small for the grand office of storeroom and other functions, when I came to your kind and noble letters and then I stopped and the fire went out.

I have recently paid a brief visit to my father at Moscow where linger the very kindest memories of you."

Even while Hall was fretting himself and scolding Hayden over the outcome of the expedition to the Bad Lands, Hayden, fully appreciative of his obligations, writes to him from Fort Randall, Dakota (1858), that "nothing would give me greater pleasure than to be in your employ or in any way connected with you in exploration. There is no one whose good opinion I more earnestly desire, for whose labors I have a higher regard or whose friendship I could more value than yours."

Barrande, the greatest European palaeontologist, had begun to honor his American colleague by naming species in his honor (1853), a practise which he long continued. A letter from John J.

Bigsby,⁴ an English geologist very familiar to Americans, gives pleasant news and an interesting picture (1858):

* * * * "I need not say that the Geological Society awarded you in February last the Wollaston medal without a dissenting voice. A man must acquire extraordinary attainments nowadays to write up to the Wollaston medal. Geology in England is only tolerably active. Three or four persons are working perseveringly and successfully in new and dark directions; W. Hopkins at this moment laboring on the effects of pressure on mineral substances aided by powerful machinery; Falconer on the Indian fauna; Sorby on the aqueo-igneous structure of granite by the help of the microscope and Beckles on the occurrence of kangaroo rats in the Purbeck beds of England. Lyell is very busy elaborating his recent researches in Sicily. His love for *Geologia* suffers no diminution. Mr Ramsay, Professor in the School of Mines, gives immediately at our Royal Institution a lecture on the "Influence of Geological Formations on the Scenery of Canada." He has come home full of your kindness to him. He declares his visit to America has been a most delightful and most instructive epoch in his life. He is full of the frankness and cordiality and high attainments of his geological friends across the water, as well as of the good done by the wandering visits of scientific men from city to city.

⁴Bigsby was an Army Surgeon at Quebec in 1819, and during his five years stay in America he showed much interest in geology, a science in which in later life he attained some note. Dr. Bigsby's first paper on geology had reference to the rock section on the Genesee river at Rochester (1820) and he showed his interest in American developments of the science by founding the Bigsby medal, to be awarded by the Geological Society of London for work on American geology.

For myself my whole life, a happy one, has received strong colouring from my residence in the United States and Canada. Had I time to go over again I should be far more diligent.

The new edition of Mantell's *Wonders* is beautifully edited by Rupert Jones, our young assistant secretary. He has just been appointed geological lecturer at one of our Military Colleges with a good salary. We lose our best men by dire necessity compelling them to teach rudiments all their lives long."

Hall did in fact receive not only the Wollaston medal but the surplus of the Wollaston fund, altogether the most notable award in the Society's control.

Professor Andrew C. Ramsay came to Canada for the Montreal meeting of the American Association and after the meeting visited Hall who took him over the classical localities about Albany. Hall took this favorable opportunity to borrow some money of him and we find this memorandum attached to an acknowledgment from Ramsay of repayment.

LONDON, 13 July, 1859.

"I saw Agassiz on Monday, and lunched with him at Sir R. Murchison's. We were a jolly party, consisting of Agassiz and his wife and daughter, Lord Eniskillen, Lyell, H. D. Rogers (whose face is not always strictly jolly), Huxley and myself besides our host and Lady M. Agassiz went yesterday to Switzerland to see his mother."

We have made passing reference to the troubles which nearly wrecked the Dudley Observatory, but it would serve no illuminating purpose to recount them further. Hall was in it all, now upholding the director, Benjamin Apthorpe Gould, and now impeaching him; involved with Henry, Bache and the Coast Survey; lamenting the schism which not only scandalized scientific circles but split the city of Albany wide open. He could not keep his fingers out of the boiling pot, though it was none of his and he was sure to scald them. Joseph Henry, kindly and wise, before whom as the highest official representative of science he spread, one after another, his personal antagonisms and his terrifying phantasmagoria; denunciations of Foster, Whitney, Meek, Hayden, Shumard, and now a wail of diatribe over the Observatory affairs; reproves the nerve-strained wrangler (August 2, 1858):

“Life was given to us for higher and nobler purposes than the gratification of our desire for personal aggrandizement, and it would be far wiser for us to seek our reward in the pleasure of the discovery of new truths than in the reputation which should result from such discovery. We should endeavor to fulfill our mission as humble and laborious ministers of Nature, striving to enlighten our fellow men in the truths which have been revealed to us as the result of our faithfulness and we shall in due time certainly meet with

our reward. But if the reward is the end, our hopes will not be realized.

My own opinion is that you have undertaken too much for your strength and that you will be obliged to share the field of research with others, not as your equals but as working under direction and receiving a proper share of the credit and emolument. * * * *

I would in conclusion impress upon you that life, health and above all, peace of mind are far above scientific reputation and that these ought not to be endangered by an attempt to accomplish more than your own strength or a due regard to the advance of truth will justify.

Truly your friend and servant.

JOSEPH HENRY "

This uplifting reproof seems to have been carefully pondered and, perhaps as ourselves in like case, he looked about him to see whom the boot fitted. In a few weeks he writes to Dana (September 10, 1858):

"Were I to tell you that I am an unbeliever in science you need not be shocked. It seems to me I can no longer go on and the events of the past year have again and again turned me to the resolution that, did I know enough of any respectable business or profession to earn an honest living I would at once abandon science forever and could I erase my name from every printed page and annihilate all I have done, it should be done tomorrow. This is not a sudden resolution and it is daily becoming strengthened. Still a few more years of endurance [40 years!] and it will be at an end. In Albany at the present time one-half of the best men or those who have heretofore been regarded as the best men in our community are arrayed against each other with the

most bitter and unrelenting animosity and all for science, as they say. It will require years to bring again the same harmony that existed before and some at least of the present generation will die before that event can come. * * * * What is worse I fear it will not end with Albany and the animosities engendered here will be elsewhere manifested and we are likely to have for many years the fruits of this bitterness."

Another incident seemed to have contributed to this renunciation. Jules Marcou, who had now returned to Switzerland and found a place in the Federal Polytechnic School at Zurich, had just issued a book entitled: "Geology of North America," signing himself as "Formerly United States Geologist." It was a wholly incompetent production and Dana flayed it mercilessly in *Silliman's Journal*, but Hall could not rebound from the towering affront cast upon him by Marcou, whose only reference to him was the statement that the New York Survey was principally distinguished by the sketches made by Mrs. James Hall!

Professor Hall had been kind to Marcou and had set him on his feet when he arrived in this country and this return was gross; indeed it was never forgiven nor was it forgotten decades later when a cruel attempt was made from this country to impugn Hall in the scientific circles of Europe. Desor wrote from Neuchatel (March 15, 1857) to

tell Hall that European geologists were scandalized by Marcou's book and that his patron Elie de Beaumont was determined to get rid of him.

But let us look again at the other side of this barometrical spirit. There was a German doctor in Burlington, Iowa, by the name of Otto Thieme, a bit of the high-class wreckage of 1848, washed by the Atlantic on American shores. He says of himself:

"I have been an old doctor of Weimar where I was placed thirteen years alone as tribunal and head physician. And besides it I studied always natural sciences for which I was prepared especially as assistant of the renowned anatom Johannis Muller of Lichtenstein, Burmeister, Link, Weiss, etc. It has been in former time my aim of life to prepare myself in every way for investigations of strange countries in regard of natural sciences, but the carrier was changed. I became only physician and I did continue to study besides my business in private especially zoology and botany. My whole house was filled with a beautiful museum. Finally my life has been broken by an unavoidable awful domestic misfortune and the only way to save me was the sudden resolution for emigration. I lost all and came like a shipwrecked man to America. I have till now only to intend to make my life and to prepare myself more and more in English language. All my collections I made around Burlington and all my peculiar observations I sended to my home for scientific use. At present I am sorry of it and I don't any more because I imagine they would be at next time more important for this country. Now I am going to come forward by writing. I wrote in the last time for the German

newspaper about the surroundings of Burlington and I hope I will finish next winter a German book about physical geography of Iowa to which I feel particular influenced by your geological report. You appears to me the right source for scientific life, the man of the power to raise up a man of higher intentions from this obscure place. One word of your lips if some opportunity would be sufficient to bring me nearer to the science. I offer myself for use to some expedition for assistance of a museum and scientific institution because I am convinced even by a small salary to effort everywhere a better existence besides as physician and by writing. I hope I may become worthy of your kind doing for me, if you would so soon my gratitude should never be extinguished."

Such an appeal "to the man" never went unheeded; money and employment, specimens and publications went out to him, with recommendations to friends in Iowa which brought him in touch with his desires to such a degree that his name is conserved in the geology of that State.⁵

⁵ Mr. Frank Springer, who knew Dr. Thieme, writes me:

"Thieme was a man of unusual learning and accomplishments. By profession a physician, he was a lover of nature, and collected extensively, from insects to fossils, especially the crinoids of the Burlington area, of which he made a fine collection, which after his death passed into my hands. He did a more important thing for Palaeontology, however, by inducing Wachsmuth, whose physician he was — then a merchant and in ill health, and knowing nothing of fossils,—to go with him into the hills and quarries of Sundays, collecting crinoids. This was primarily for the sake of exercise and health, but it was the beginning of Wachsmuth's interest in the subject, to the study of which he gave so many years, with such important results for the benefit of our science."

When the election came to the Presidency of the American Association, Colonel Jewett sends a characteristic message:

UTICA, *April 23, 1856.*

We have had a rejoicing on *your* account this morning. Lincklaen wrote me a jewel of a letter and told the fact that you are President of the Scientific Association. Why did you not inform me? It is one of the best things of the year. How it will please the Deacon [Emmons] and Gebhard!! And will not the good people of Albany think by and by that you are "some"? But it astonishes me that the congregated Science of the United States should elect a "Jesuit" to preside over their deliberations — it is worse than making one a Chief Justice of the Union [Taney] if possible — but that awful wretch of a Jackson did the latter and he had no regard for law or gospel.

Please accept our very hearty congratulations. The act is one of those now so very rare, bestowing an office on a man eminently worthy of it. Wife has bid me extend the congratulations to Mrs. Hall — which reminds me of the old Yankee story of the good yeoman who was elected Corporal, and his small boy said "Mother are we all Corporals"? She told him "No, you little goose, only your father and I."

We have had occasion to refer to Mr. Whitfield's work in connection with the Survey of Iowa and Volume III, and further notice of his assistance to Hall may be necessary, for he remained with his chief twenty years; longer than any of his predecessors or followers, and in this period achieved an excellent repute for his workmanship. Mr. Whitfield came to Albany in 1856 on the

recommendation of Colonel Jewett. He was then an apprentice in the Chubbuck establishment at Utica, which was a manufactory of scientific instruments, and here with his natural love of fossils he had opportunity to train himself in draftsmanship. Hall needed such a man and offered him \$550 a year and a house, to which Mr. Whitfield agreed with the condition that he should work eight hours a day. Hall demurred; he must have an assistant who would be on hand whenever needed, for he says, "there is no time when I might not want something done that it would be extremely difficult to wait for till another day"; and it was under this day-and-night arrangement that Mr. Whitfield took up his labors in Albany.

CHAPTER IX

THE PERIOD OF VOLUME IV—1860-1867

Concluding Procedures in Iowa — Reorganization of Iowa Survey — Dissolution of Wisconsin Survey — New York "Regents Reports" — Modes of publication — Fossil plants — Troubles with the "Quebec Group" — Report on Graptolites — Reorganization of State Cabinet — Hall Director of new State Museum — The Cohoes Mastodon — Grove K. Gilbert's first work — Death of A. A. Gould — Hall buys his collection of Mollusca — Lewis A. Morgan, founder of American Ethnology — His first publications in "Regents Reports" — Sir James Anderson — Intimate relations with Hall — The Civil War — Dissolution of Southern Geological Surveys — Carl Rominger — Hermann Credner — John J. Bigsby — Edward S. Morse — Edward Orton — The geological Methodist.

IT was characteristic of Professor Hall's mode of work now, that the prosecution of his official researches should proceed without demonstration or break. But this procedure came gradually and there were still many outside connections to cut loose from.

The complacency and pride he had felt in the scientific respectability of his Iowa reports was, we have already noticed, not enhanced by his experience as State Geologist of Wisconsin. In both States he was now in hot turmoil. For Iowa he had printed a volume on Geology which covered but the

eastern part of the State; into the coal lands he had barely entered. He had also printed a rather sumptuous and very excellent volume on Fossils. His plan was for subsequent volumes on both themes, especially on palaeontology and for these he had gathered extensive materials. But expensive books on fossils were not what the Iowa taxpayers were looking for when the Survey was authorized, and in spite of the high scientific merit of these reports, the press of the State was critical and very hostile to the continuance of the organization. In 1860 the legislature refused to make any further appropriation for it, and they would not reverse their decision in spite of Hall's appeals to his friends, Senator Grimes, Judge Lowe, and to Samuel I. Kirkwood, who was Governor in 1862. Naturally this correspondence ran into rather specific acrimony toward some of his assistants who he believed were trying to unseat him, even though, as he insisted to his friends, he had the material ready for additional volumes. For several years he regarded himself as State Geologist of Iowa because the legislature was without power to repeal the contract made with him by Governor Grimes. Dr. Charles A. White, whose services Hall had reengaged in anticipation of favorable action by the legislature of 1860, was kept active in Iowa and New York. But White, as a citizen of Iowa, was desirous of having the Survey

continued along lines that would be acceptable to the citizens. This very suggestion set off Hall's explosives, though White was too loyal to Hall to be disturbed by any accusations of infidelity. "Mutual friends" helped to start some fires but Dr. White never flinched in devotion or in judgment. In January 1865, he writes to Hall, referring to some unfair comment in Iowa regarding Hall's administration:

"I take this occasion to remark that during nearly seven years of correspondence and two years of intimate relation with you no word or act of yours has given me cause to complain, but that so far as I am concerned our intercourse has been every way agreeable and profitable, and if I had followed your advice in relation to scientific pursuits I might have made myself an honorable name in science instead of wasting my life as a village doctor. I regret exceedingly that any person, particularly any Iowan should so far forget himself as to make disparaging remarks concerning the unusual efforts you have made at great pecuniary loss to yourself to save to science and the State a work of such importance to both."

Soon after Doctor White stated the situation in Iowa clearly:

May 2d, 1865.

"The repeated refusal of the legislature of Iowa to respond to your requests for the appropriation of money to resume and complete the State Geological Survey or to refund to you the money actually expended by you on the work after your term of appointment had expired, would

of itself convince one that there is great dissatisfaction among the people and their representatives with the result of your labors here, if I had not the additional assurance of the fact from the mouths of a number of the members of the legislature who have told me that it was the definite intention of the legislature not to recognize you as State Geologist after the expiration of the term for which Governor Grimes appointed you. Every scientific man however knows that your report was a valuable addition to science and the objection urged against it by others does not arise from a disbelief in your ability, but they consider that you are more desirous of adding to your scientific name than of instructing the people of the State in relation to its resources. I have earnestly endeavored to have our legislature comply with your wishes in this matter, as you are thus aware, without any expectation of personal advantage, but since it has become certain that we are to have peace, I have addressed a number of my scientific and other friends, suggesting the probability that I should ask our legislature next winter to make an appropriation to resume and complete the work and appoint myself in charge of it."

He then asks Hall for his recommendation for the place and Hall, still insisting that he is State Geologist, sends him a strong endorsement saying that he had intended to eventually turn over the Survey to him, but he claims his right to print his reports as soon as the legislature of 1866 is in session. He writes to the new Governor, William M. Stone, a strong appeal to be allowed to print these accumulated documents. He got no satisfaction. Doctor White was appointed State Geologist

and Mr. Hall was left with claims for unpaid salary, for large costs incurred in illustrations and with really valuable manuscripts. Some of the latter, which related to palaeontology, he printed partly at his own expense and partly in the "Regents Reports," but his disbursements were not refunded.

If there was trouble in Iowa there was no less in Wisconsin and indeed even less ceremony. The Wisconsin legislature in 1862 referred the whole matter of continuing their Geological Survey to the Committee on State Affairs and after what seems to have been a careful inquiry, they stated that the Survey had already expended \$30,000 without any return whatever except one volume of a report at an extra cost of \$3.00 a volume. The Committee thought the sum "ample to have secured the services of three capable men, but managed and conducted as it has been by the present Commissioners it has proved a failure in every respect except in the expenses incurred." They concluded the matter by expressing the opinion that "the Commissioners have violated the contracts on their part by a gross neglect of duty and the State is released from any further obligations under said contracts."

Hall went at once to Madison and told Governor Harvey personally that he intended "to go on with my work as if there had been no action of the legislature for I regard that action as not affecting

my contracts." He did go on, but he knew he was proceeding at his own risk. Wisconsin would have no more to do with the Survey; it would not even listen to the proposals of Hall's assistant, T. J. Hale, who offered to complete the work for a pitiful sum. Mr. Hall was again left with important manuscripts, large disbursements for drawings, a geological map of the State and an unpaid salary. The State map was afterward printed by him privately, for as he says to I. A. Lapham, in 1863, "it was made from information collected under my direction and paid for by me."¹

There were also some "supplements" to his report issued by him personally. From the point of view of results obtained these Surveys in Iowa and Wisconsin yielded a harvest of disappointed hopes while Hall's financial loss was disastrous. He says he expended \$25,000 on them of which he got back nothing.

It seems fair to add this comment regarding the mischances in Wisconsin. Hall had engaged Josiah D. Whitney to make the report on the lead region where very active operations were under way. Mr. Whitney was undoubtedly the most competent per-

¹ Geological Survey of Wisconsin, James Hall, Direct. Geological Map of Wisconsin, Showing the Relations of the Geology with that of the Surrounding States, compiled from the work of the Geological Surveys of Wisconsin and Iowa and from the Surveys of Doctors D. D. Owen, Foster and Whitney and Professor A. Winchell.

son he could have found for the work. "I really thought" he says, writing to Professor William D. Whitney, of Yale, his brother and his coadjutor in these early days, Josiah D. having at that time [1862] begun his California work; "I was doing the State great service in securing your brother and in carrying out this work. No one else could have done it so well." The trouble lay in the fact that Whitney had shown very clearly with his sections and his "Crevice-maps," that the lead deposits were shallow and so he frankly discouraged "deep mining." To this advice the miners were openly and for some reason bitterly opposed. It seems very probable that this opposition on the part of empiric ignorance dealt the death blow to the Survey. Hall at least tried to make W. D. Whitney believe this, much to that distinguished philologist's indignation.

Over all these miscarriages and their consequent misrepresentations Mr. Hall was much troubled and President Hitchcock writes him from Amherst:

"It is hard for men who have labored as you have in the cause of science to be assailed by those who would tear off your laurels and prove you selfish and dishonorable. But you have the consolation of knowing that when such attacks have spent their force your reputation in the scientific world rises too high to be reached by such assaults. In such cases if you can keep *Old Adam down* it is perhaps the best way to make no reply."

In the early days of this period Hall was poor and he was lame. He writes to G. M. Kellogg of Iowa, to whom he owed money for the use of his crinoids: "I doubt whether at this time I could secure for myself a loan of \$600 on everything I have. I have no money myself, having incurred debt and responsibility in the Iowa work." He had tried to stop a runaway horse on the Albany streets and got knocked down with a bad wrench to his leg which developed a protracted sciatic lameness, so that for a year or so he hobbled about on crutches. The combination of sciatica with a naturally irascible disposition made geology and palaeontology a fiery field in these days, and if any Roland felt called upon to break a lance on this field he found a *lion malade* in the corner. We may in perfect charity ascribe many of the contentious outbursts of these years, against his colleagues, Billings and White, Winchell and Worthen, even against Logan and Dana, to the act of chivalry that impelled him between a wild horse and a hard road.

Despite crutches and western surveys, Hall was incessantly productive at home and many of his publications of these years were of highest merit. He had now begun to make the "Regents Reports," that is, the "Annual Reports of the Regents of the University of the State of New York on the Condition of the State Cabinet of Natural

History," the outlet of his palaeontological researches, and though at this time he had no official relation to that institution, the publication of these researches imparted a permanent value to those official documents.

Out of the multitude of his varied studies some were rather discursive but others were of sustained value, especially those which bore upon the intimate structure of those important fossils, the brachiopods. For this work he was drawing his suggestions in very large degree from the refined investigations by Thomas Davidson, of Brighton, the highest authority of his time in this field, with whom he had already carried on an intimate correspondence for many years; an exchange of scientific interests which was maintained for long years afterward, even to the time, twenty-five years later, when the study of these interesting creatures was revived on broader lines, with the present writer doing the work.

These researches into the anatomy, the delicate internal structures and the interrelations of the Brachiopoda were preparatory to Palaeontology IV, and as a given group was brought toward completion he thought it wise to insure against delay by prompt preliminary publication.

We have just noticed, in speaking of the discovery of the Permian, how it often happens in scientific researches that the eyes and the minds of

several investigators are unconsciously focussed on the same field at the same time. Two astronomers in different countries searching for a calculated but undiscovered planet, find it on the same night; and more than two palaeontologists now had their minds intent upon the study of the brachiopods and they were constantly arriving at the same goals at about the same time. Hall was pioneer in the American field, indeed he had done so much more than all others that he doubtless felt a certain proprietorship which was disposed to withstand invasions of his domain. And when Mr. Billings of Canada, or Alexander Winchell of Michigan showed signs of too much attention to these matters, Hall was very quick to insure his rights of discovery through his avenues of publication. It was often a race, and those he distanced were wont to criticise him rather severely for his procedures. And so there is no little humor in the situation when he answers his critics by telling them that he is hobbling about on crutches and is thinking of consulting Dr. Dio Lewis for his lameness.²

² "Doctor" Dio Lewis was a well known "healer" of the day and pioneer of "physical culture." Augustus A. Gould says of him, in answering Hall's inquiry:

"The man to whom you refer is, I presume, the one who styles himself *Doctor* Dio Lewis, teacher of gymnastics, who has a sort of Infirmary at Lexington where he treats invalids by exercise, kneading, cold water, inflating the lungs and all that sort of thing. He *cures* in the primitive sense of the word—takes *care* of—and has a set of original long bearded, supernaturally wise, unmedical

Hall would issue his results in pages printed and dated "in advance" of a Regents Report, but by the time that Regents Report came out this publication might have grown to vastly greater size. Official delays in printing sometimes put the dates on these researches back in quite unbelievable way, and Professor Winchell expressed his admiration of Hall's ability to secure such amazingly quick publication: "I notice that your paper was read before the Albany Institute, April 29, and was published May 2."

But in spite of these competitions, the quality of his researches was not marred and the same excellence was evident in the various other themes of palaeontology which he touched upon; Graptolites, Crinoids, Mollusca. His attention for a while was much engrossed by the fossil plants. In his years of examination of the New York rocks he had found many of these but had never accumulated them for special study, though by training he possessed a full equipment for ancient botany. John William Dawson, the distinguished Principal of McGill University, born and raised in Nova Scotia not far from the fossil coal forests of

men about him, to carry out his notions. Any one who wants to consult some self-conceited, wonderfully gifted person of that kind, may well consult him. For any lady who is dyspeptic, lazy, notional, his dumb-bells, rings, jumps and twists and stamps do admirably, and wake up the sleeping energies. For one who *really* has a disease I should recommend some reputable, standard bona fide doctor."

the South Joggins and the "Devonian Fern Ledges" of New Brunswick, was assembling and describing the Devonian Flora as represented in the deposits of Canada East and to him Mr. Hall tendered the use of the plants which he had gathered from the Devonian of New York. In the opinion of Sir William the assemblage of plants thus brought together was larger and more variant than from rocks of the same age in all the rest of the world, and his publications on this theme were of elemental importance, as they are still today. Mr. Hall reprinted the part of Sir William's papers that pertained specially to New York, and accompanied them with observations of his own upon the Devonian Flora. Then by one of his auto-suggestive impulses he proceeds to describe and demonstrate as plants certain retort-shaped and spiral bodies in the rocks; "cock-tail fucoids" as they had been called by some of the earlier writers, and other strange and graceful shapes, vases and cylinders, with a netted surface (*Dictyophyta*) cross-woven like basketry. But none of these "plants" have stood the test of time; the spire-plants (*Spirophyton*) seem to have been the markings made by sea-worms half buried in the mud, and when he described the *Dictyophyta* he was unconsciously laying the foundation for one of the most excellent and most elaborate of all the great monographs he initiated, for these "plants"

proved to be glass-sponges and were the heralds of a vast array of beautiful objects from the sponge fields of the Devonian and Carboniferous rocks. Hall did not live to see this latter exhaustive and magnificent treatise completed.

Troubles with the Quebec Group.

Among many matters of technical interest there was one which had some special and some controversial concern, and which still retains no little historic value both as an illustration of the evolution of geological conceptions and as an element in the "Taconic Controversy," to which we have already made various incidental references without intention of carrying it into its various and complex ramifications.³ Our concern is now untechnical and only with Mr. Hall's part in it.

The State Geologists in their early reports had agreed to call the dark shale beds with their interbedded sandstone layers, which fill all the valley of the Hudson, extend into its upper reaches, off through Washington county eastward to and into Vermont, and westward far up the Mohawk Valley, the "Hudson River Group," and its geological position was set as the highest term of the Lower

³ The development of this problem and the controversies it educed have been put forth clearly and impartially by Dr. George P. Merrill (Contributions to the History of American Geology; Report U. S. National Museum, for 1904, p. 659, to which the interested reader is referred).

Silurian System. Now the Washington county region of these shales was indicated by Doctor Emmons as the locus of his Taconic System and it was there that he found the fossils which he claimed, with entire justice, to be older than any other organic life yet discovered in America; a claim that was, at the time, generally contested. When Hall issued his *Palaeontology I*, he described and figured one of these primordial trilobites found by Emmons, and without discussion or debate referred to it as from the shales of the Hudson River Group. Not long after this the primordial trilobites of the slates at Georgia, Vermont, were discovered and collected by several geologists, Dr. E. Hitchcock and C. B. Adams; Billings, Logan and by Hall himself. After waiting a respectable season and finding that no one else was disposed to describe these impressive trilobites, Hall did it, in 1859, ascribing them all again to the Hudson River shales. The error was now an egregious one for in the interval the character of the primordial fauna had been clearly demonstrated and Hall himself, in his correspondence with Barrande and others, had conceded the primordial type of just such trilobites.

Now, as it has turned out, the real valuation of this formation, the Hudson River Group, obscure even to the early geologists and leading everyone who took hold of it into a blind alley, has proved

to present the most complicated problem in the historical geology of New York. The light began clearly to dawn with Mr. Walcott's investigations which set down a score or more of places in these eastern regions where Cambrian or Taconic fossils were to be found. Twenty years of consecutive and refined research on the part of Mr. Ruedemann of the New York Survey have made clear the fact that this comprehensive mass of homogeneous deposits is ten times as thick as it was thought to be by Hall and his associates, and instead of being a formation having a definite geological position at the top of the Lower Silurian System, as the early geologists construed it, it represents, in shale and sand, every unit term of that System from bottom to top and also several well recognized elements of the Cambrian formation beneath.

These determinations have been based wholly on the results of an unceasing search for palaeontological evidence which has produced unlike and successive faunas in most unexpected variety.

In the first years of Sir William Logan's work in Gaspé and the Lower St. Lawrence (1843) he had taken account of the deeply folded masses of dark shales lying upturned beneath the limestones of the "Silurian" series. These he traced up the St. Lawrence to the promontories of Quebec and Point Levis and in 1848 he wrote of the great development of these "Hudson River" shales here

and on the Island of Orleans. Finding in them a great abundance of Graptolites in what he regarded the higher beds, he proposed in 1860 to call these Graptolite beds the "Quebec Group." Sir William believed he had fortified their position by a special exploration of the country from eastern New York across Vermont and the region of the Georgia slates, into Quebec, begun in company with Hall in 1859 and carried through by himself. With the assurance from Sir William as to the position of the Georgia slates and of the Quebec slates, Hall, surrendering his better judgment in deference to the great stratigraphical skill of Logan, published his account of the Georgia trilobites which in truth were the most palpable primordial fossils that America had produced.

He finds himself bombarded at once by interrogatories and reviews and, much to his dismay, he discovers Sir William himself, in a published letter to Barrande and directly thereafter in his monumental *Geology of Canada* (1863), qualifying his own stratigraphic conclusions, and impressed by Barrande's conception of "Colonies" ⁴ or the idea

⁴ Barrande's conception of "Colonies" was that certain faunal assemblages having the stamp of definite geological age might, under conservative conditions, such as withdrawal from the scene of active physical changes, escape modification and reappear unaltered in rocks of later date amid faunas altogether changed. The idea was immediately challenged and severely criticised and while the conception acquired a certain vogue because of its novelty, reexamination of the Bohemian rocks has shown that Barrande's "Colonies"

of the sudden recurrence of faunas in rocks of later date than their normal position (a brilliantly illustrated interpretation which had the vogue of a generation) suggesting that the Georgia trilobites were such recurrent Cambrian "colony." It seems well to interpolate here some extracts from the voluminous correspondence on this theme precipitated by the Georgia trilobites.

Hall writes to Joachim Barrande (October 15, 1861):

"I thank you most cordially for your generous expressions in explanation of the causes which induced me to refer such very distinct primordial fossils to the Second Fauna. It was true indeed that I felt some doubt and I had more than once spoken to Sir W. E. Logan on the subject. I held them in my hands for more than two years believing and yet instinctively doubting the views of stratigraphy which prevailed in regard to the Vermont rocks. To show you my original views I inclose some parts of sections made by me across this country in 1844 and 1845 and these with others were brought before the American Association of Geolo-

at least are due to physical displacements of the strata, however correct may be the idea of a "recurrent" or returning fauna. Barrande wrote much in "Defense des Colonies" and in a letter to Hall, August 27, 1862, he says of the attacks upon him: "I shall occupy myself in Bohemia in following up their *polemique*, if my contradictors do not acknowledge their errors which are of a very grave nature. At the bottom this whole manœuvre, little scientific, has been directed against a '*living colony*' in Bohemia. That colony is *myself*; this is the entire secret." Barrande, a Parisian laboring in the great Silurian basin of Bohemia under the patronage of the Count de Chambord, was then sensitive to his exclusion.

gists and Naturalists at their meetings of 1845 and 1846 and the subject was most fully discussed at these and other meetings. Dr. Emmons contended that the slates were below the Potsdam sandstone and Prof. Adams that the sandstones were not Potsdam but a newer rock. These sections I had originally intended to incorporate in my first volume of the *Palaeontology of New York* but from the differences of opinion and distrustful of my own ability, I withheld them till I could have time to review my work. Then came in 1847 or 1848, the views of Sir W. E. Logan that the rocks of the Green mountain range had been traced northward till they became nearly horizontal and unaltered but containing the usual fossils of the Hudson River Group proving them to be of the same age. This view was supported by the chemical researches of Mr. Hunt, who asserted that the unaltered fossiliferous beds had the same composition even to certain peculiarities and the presence of rare minerals. To these conclusions I gradually yielded and gave up my own views of physical structure.

After the discovery of the Georgia trilobites in 1857, I wrote Sir William Logan to go to the locality with me as it was near where I had made a section of the strata, but he expressed himself that there could be no doubt regarding the position of the rocks. It was only in June and July 1859 that he visited the place and I awaited his return before publishing an added account giving his authority for the positions of the slates with trilobites, he having identified the rock which I considered Potsdam sandstone as the Oneida conglomerate or Medina sandstone.

I could hardly suppose that these primordial 'trilobites were existing in that period as a colony and my faith in the structural views of Sir W. E. Logan supported by the chemical results of Mr. Hunt made me willing even to doubt

the correctness of the conclusions you had arrived at in Bohemia.

In September 1860 Sir William Logan was with me here and upon our rocks in this vicinity. He assured me at that time that there was no possibility that the rocks of Quebec could be other than had been represented and even in November after revisiting the locality I had the same assurance.

However, there is still another point which you will doubtless look for. In my volume I of the *Palaeontology of New York*, published in 1847 but printed in 1846, I have introduced *Olenus* as from the Hudson River Group. At that time we had no knowledge of a "primordial fauna" and even after we possessed this knowledge this example was affected by the same reasoning as the others. The typical localities of the Hudson River Group in the Hudson Valley at, above and below Albany are of the same slates — rocks of the same age. The Graptolites which I have described from the Normanskill are deep in the exposures of a denuded anticlinal fold and must be placed in these primordial slates. Graptolites which we have been counting upon as so characteristic of the Second Fauna are far more abundant in these later slates.

Dr. Emmons did not at first nor for a long time claim for his Taconic System an extension to the Hudson River Valley, but fully believing that my colleagues in the Geological Survey had ascertained the continuity of the rocks of the valley of the Hudson with those of the Mohawk Valley at the west, I contented myself with working from this valley eastward and proved as I thought (and as it now proves true) that there were no series of slates older than the Hudson River Group between the Hudson River and the Massachusetts line.

I take great shame to myself for having first abandoned the position I had taken regarding the physical geology and adopting the views of others and eventually yielding my palaeontological opinions in the same direction."

Mr. Hall writes to Benjamin Silliman (January 10, 1861):

"You are probably aware of the position Sir W. E. Logan has taken in regard to the Quebec rocks, etc. Up to the 20th of November his word to me was stronger than ever that there could be no doubt of the position of the Quebec rocks. I am sorry that he could not on stratigraphic grounds have maintained his position. I have gone with him fully and all his Graptolites are cited from the Hudson River. Even the latest writings for the Decade place the shales of Canada in which I have recognized groups identical with those of New York as several hundred feet below the Quebec or Pt. Levis rocks. I feel that there is yet a fallacy somewhere and were I in communication with W. B. Rogers I should urge him to insist on stratigraphical proof. As for me after all that has been said, I can only go back to my palaeontological convictions."

To Edward Hitchcock (January 26, 1861), to much the same effect:

"I ought to have written you before now in reference to the shales of Georgia, Quebec Group etc. When I wrote I had no definite information that Sir William Logan had abandoned his position, which to the 20th of November he had strenuously maintained. You have, I dare say, before this time seen his letter to M. Barrande. He has in that abandoned his ground and gone to palaeontological evidence.

The volume of this evidence you will be able to determine when you see my communication to Silliman's Journal.

Now the case appears to me to be simply this: Sir William has abandoned his own ground of stratigraphical sequence and has gone to palaeontology. This palaeontology if correctly determined completely breaks up the scheme of successive faunae of Barrande and we are in fact again quite afloat. In this state of the case I certainly feel greatly dissatisfied, for it seems to me that Sir William, whose position in stratigraphical geology is second to no one, should not have given up his ground in this way but should have insisted on a more thorough determination of this Primordial fauna."

In a long letter to Sir William E. Logan, dated November 23, 1861, Hall says, among other things:

"Everyone must know that from the first we all recognized these Trilobites of the Georgia Slates as of primordial types, and in making my species I referred them to such types even while taking you as authority for saying that they were found in a higher formation—and for myself I gave up my opinion founded upon the fossils alone, and in my reverence for your ability as a stratigraphical geologist did violence to my palaeontological opinions.

So long ago as 1845 I made a section across Vermont and then recognized the Potsdam sandstone in several localities. I referred the only fossil I knew to *Conocephalus*. After my section was engraved and printed and I had an opportunity of publishing it, I sent a copy to Adams who interpreted differently the phenomena, but his original section I still possess. Then came your announcement, not prompted by anything from me, for I had said nothing to you on the subject, that you had traced the folded and con-

torted slates of Vermont into Canada where they assumed a horizontal condition and they were already of the age of the Hudson River. When about publishing the fossils from Georgia in 1859 I waited a month to see or hear from you, knowing that you were examining the Vermont rocks at the points I had examined fourteen years previously, and there seemed still a hope that you might see as I had seen them so far as the sandstones are concerned, and this might change the whole aspect of the matter. On your return you assured me in the most emphatic manner that there was no possibility of making out anything older than shales of Hudson River and the sandstones you considered as Medina &c, and you regarded the Quebec group as still higher than true Hudson River. Again, in September 1860, and even later, in November 1860, I had from you the same unequivocal assurances. My "palaeontological views" were certainly not in favor of the interpretation you had given to the rocks, and I confess to too much yielding to your stratigraphical conclusions in placing the primordial types of Olenus in your Hudson River rocks."

And this clear statement to Agassiz (December 16, 1861):

MY DEAR AGASSIZ:

I enclose to you two sections made by me in Vermont in 1844, and brought before the Association of Geologists &c in 1845 and 1846 and fully discussed then and subsequently with other sections of 1844 and 1845. You will see that I recognized *Potsdam sandstone* and slates resting upon it. Emmons contended that the slates below were Taconic, and Adams that the [Highgate] sandstone was *Medina sandstone* or something newer than Hudson River.

In 1847 and 48 came Logan's views, and following these from a physical aspect came the chemical demonstration by Hunt that the fossiliferous, now metamorphic, slates of the Hudson River Group, where they spread out in a nearly horizontal position on the north, were the extension of the Green Mountain shales etc. and none other than the Hudson River. I gradually acquiesced but finally advocated these views so strongly put forth by the Canada Survey and withheld my engraved sections till I could review my work, a time that has never come, and now so far as I can learn, I am to be accused of having led the whole geological world astray.

These sections as you see them engraved were in the hands of Adams, Hitchcock and others, and after contending long enough I have remained quiet. I remember well your remarks last winter when you saw that I was trying to sustain Sir W. E. Logan's views, or rather to explain in some plausible manner what did not seem very clear in his exposition of Quebec Rocks. Really it is very strange that fourteen years working on these rocks should not have given the true explanation of the physical structure. One of my Vermont sections is near or at a place he examined in 1859 and made the rock Medina sandstone or Oneida conglomerate and gave me the assurance that the Olenoid trilobites were in the upper part of Hudson River Group.

I am truly your friend

JAMES HALL

And in this struggle to get himself right he sends the same story to Dana and some others.

The term *Quebec* has now passed out of recognition in the Palaeozoic series of formations. It served a useful provisional purpose in much the

same sense as did the term *Hudson River* but both have gone the same way with the resolution of their component parts. It was not therefore a very helpful procedure when Dana, in one of the early editions of his "Textbook," proposed the term *Canadian* for the entire complex of these debated rocks of the Upper St. Lawrence and the Eastern Townships. The name was offered in testimony to the labors of the Canadian geologists in this field but it was protested by them and Sir William Dawson characterized its "absurdity" in view of the fact "that Canada is a region greater than the United States of America and with equally varied geological structure."⁵ The term, shorn of its original intention is still permitted to remain, a vestige of an inconsiderable distinction.

Out of the churning of these debates came at last the Memoir on the Graptolites of the Quebec Group as Decade 2 of the Canadian Survey. It was the culmination of investigations begun in 1854 at Point Levis, and as these discoveries grew with the constant restudy of the debated ground, so the researches became enlarged and enriched during the eleven years in which they were carried out. This account was by far the most refined and brilliantly illustrated investigation of the Graptolites which had been made, and it creates a very

⁵ Harrington's "Life of Sir William Logan." Appendix A. p. 415, 1883.

definite epoch in the study of these singular and, at that time, little understood creatures. No one had grasped the nature of these animals and their high value in the determination of geological horizons had not been at all apprehended. Professor Hall brought out an army of genera and species and gave a clear analytical study of their composition. He demonstrated the fact that he was dealing with compound creatures growing in colonies and he first recognized their true mode of growth. He made out their fundamental structures and depicted what he believed to be initiative parts which he called "reproductive sacs" and "germs" and though these parts are otherwise construed now, yet these determinations doubtless stimulated investigators both here and in Europe. He showed that the Graptolites were floating colonies in the old seas and on the whole he conceded their relations to the simple or hydroid corals. These are in the main well accepted interpretations today, but it is of interest to find in a letter to Logan, March 25, 1858, an expression that he would be much inclined to regard the Graptolites as bryozoans;—a view which in later years has been urged by several writers. In these studies there was little ahead of Hall except the work of Barrande, the eminent Bohemian palaeontologist whose investigations on the Graptolites of the Silurian were published in 1850. A very important conclusion from this work

was the determination that the Graptolites of the Quebec shales were entirely different from those that he had described from the Hudson River shales at Normanskill near Albany and he would not now surrender his convictions in favor of Logan's stratigraphy, although he never publicly changed his view of the "Hudson River" age of the Normanskill Graptolites. Mr Ruedemann's intimate study of these Graptolite faunas upholds Hall's judgment of the greater age of the Quebec fauna making it a basal term in the Ordovician while the Normanskill is one stage higher up, though far below the "Hudson River" beds as Hall conceived them.

The State Cabinet of Natural History

Thus far, as we have noticed, Mr Hall had no official relation to the State Cabinet of Natural History. He had made and unmade its curators, was obliged to supply it with a stipulated part of his collections when these were gathered with the help of State money^{*} and he had been permitted by the Regents of the University, who were charged with the care of the Cabinet, to publish his researches in

^{*} This was a specific provision. Money was appropriated for the preparation of the researches and it was for him to decide how far the collection of materials was a necessary part of them. If he spent this money on such collections then the State exacted a portion of them for the Museum,—at one time one-third, at another one-half. The rest were his.

their annual reports. Year by year these contributions became larger until they constituted the principal part of the reports and certainly added worth and perpetuity to them. The "Cabinet" grew out of the Natural History Survey. On the representations of Dr. Emmons and Hall, two or three small rooms originally were set aside in the old Capitol for the reception of these "natural curiosities" and very soon after, their custody was transferred to the Regents, who appointed John Washington Taylor the first custodian of the State collections. He was soon followed by John Gebhard, Jr. of Schoharie, in the early fifties. Gebhard was an indefatigable collector and the collections soon outgrew their little rooms in the Capitol. They were then transferred to the Old State Hall at the corner of State and Lodge streets and assigned space among the administrative offices. The Regents and the Legislature both recognized that this arrangement was not greatly for the better and, in 1855, when Myron H. Clark was Governor, provision was made for the remodeling of the entire building for the purposes of a Museum with necessary offices and lecture halls. This was done and, as we have already had occasion to observe, the building was duly dedicated as the "Geological Hall" and at once became the most impressive State building for science in the country, housing a museum already grown to special excellence in geology and

palaeontology. Mr Gebhard, to whom very great credit belongs for the growth and development of the "Cabinet" during this period, presently retired with the published appreciative thanks of the Regents and amid thunderstorms of denunciation in Hall's letters to Lincklaen, Leavenworth, Martin B. Anderson⁷ and John Seymour,⁸ and he was followed by Hall's collector and devoted admirer, Colonel Ezekiel Jewett. Colonel Jewett was suffused with zeal for the welfare of the "Cabinet"; he was not only a great collector but an expert student, though he lacked something of the sense of order necessary to a good curator.⁹ Colonel Jewett came in 1857 and in a few years Hall, with large ideas of what a scientific Museum should be, had become impatient with him, until at last in 1865 the Colonel gave it up. Meanwhile Mr Hall had per-

⁷ President of Rochester University.

⁸ Brother of Governor Horatio Seymour.

⁹ Raphael Pumpelly, in his delightful volumes of "Reminiscences," (1918) tells of how he owed to Colonel Jewett advice which made a turning point in his career. Pumpelly had returned to his home at Owego, N. Y., after six years of study and desultory roaming among the high spots of Europe and with no immediate aim or objective in mind came to Albany to visit an uncle, Harmon Pumpelly. Stopping in at the "Cabinet" to see the Colonel, he learned from him of a mining enterprise in the savage parts of the far southwest in which Mr Wrightson of Albany was interested and who was seeking for a competent and courageous mining expert to go there. Mr Pumpelly went, escaped with his life and initiated the chain of circumstances which sent him to Japan and thus introduced him to his extended acquaintance with the Orient. Mr Wrightson himself also went, but was killed by the Indians.

sistently urged upon the Board of Regents and his friends in the legislature, plans for enlarging the scope of the Cabinet and in 1865, in response to a request of the Legislature, they transmitted a most carefully elaborated project for such reorganization. The Secretary of the Board, Dr. Samuel B. Woolworth, sent out the legislative resolution, with a request for suggestions and advice, to a number of scientific men of distinction, Mr Hall's colleagues and friends; and among those who replied at great length were James D. Dana, who specially recommended the establishment of "a School for Palaeontology at Albany"; Sir William Logan jointly with T. Sterry Hunt; Alexander Winchell, Oren Root, Alexander Agassiz on behalf of his father; Franklin B. Hough, Augustus A. Gould, J. J. Thomas, the Quaker botanist of Union Springs; and finally and at great length, Mr Hall himself. Hall's was the pertinent plan of a man who understood the significance and the handling of great collections, who saw the eminent propriety of keeping the New York State Cabinet paramount in geological sciences, who demanded large opportunities for the publication of scientific researches and, taking as his model the Museum of Comparative Zoology, at Cambridge, had no fear of boldly stating the financial requirements of his plan. Mr Hall had to deal with men of the finest ideals in statesmanship; Reuben E. Fenton, the Governor,

was Chairman of the special Committee charged with this matter; John V. L. Pruyn was Chancellor of the Board, Erastus Corning, J. Carson Brevoort, Judge Alexander S. Johnson, Victor M. Rice the Superintendent of Public Instruction, and George W. Clinton an expert botanist as well as Regent.

The result of this well conceived plan of procedure was direct and immediate; Mr Hall was made "Curator" of the State Cabinet in January 1865 and was authorized to carry out the plan for a Museum as he had proposed it and this action was supported by increased legislative appropriations.

Mr Hall was now in the saddle as the official head of two recognized State departments of science, each contributory to the other, both contributing to the same end, but each absolutely independent in responsibility.

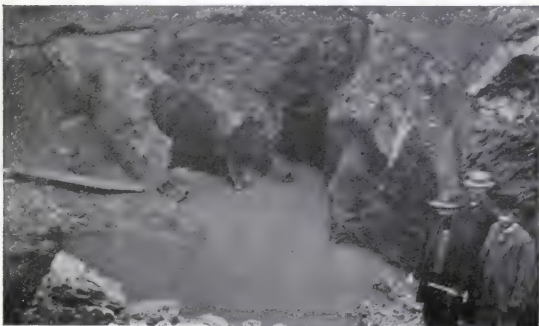
By virtue of statute the "Cabinet" became, in 1871, a "Museum of Scientific and Practical Geology and General Natural History," and Hall became its Director. The plans were laid on large lines, and Hall now entirely controlled the annual reports; but the initiation of the new undertaking was not very impressive. Mr Whitfield was charged with the arrangement of the geological collections; Charles H. Peck, an Albany teacher who had been contributing important botanical papers to the reports, was made the botanical assistant, eventually to become the State Botanist and

to render an immortal service to his State; Joseph A. Lintner was the general clerical aid and he in after years rendered good return in the capacity of State Entomologist. The cost of running this Museum in the first year of the new régime was \$2119.91.

The new administration of the "Cabinet" started bravely and by the chance of events won immediate public attention. Some of its early affairs still retain their touch upon us and on the personalities of this generation. In September 1866, T. G. Younglove, an official of the Harmony Mills at Cohoes, N. Y., a place where a diminished postglacial Mohawk River pours in cascade over the upturned strata of the "Hudson River" shale, writes to announce the discovery of a great pothole in the rocks encountered in the course of some excavations being made for new foundations and invites Hall to come up and see the curious things that were being taken out of it. Hall paid no attention to the letter. In a few days another comes telling of the finding of a lower jaw "of some unknown beast" lying on a ledge of rock projecting into the great hole. Hall went; the company enlisted all needed help to continue the excavation to the bottom of the pit, and there were uncovered pretty much the entire remains of a great skeleton. Thus was born the remarkable Cohoes mastodon; remarkable for its perfection of skeleton, for its ex-



The Cohoes Mastodon, as set up in the old Geological Hall. In front, from left to right, are Grove K. Gilbert, James Hall, Jr., M.D., and Edwin E. Howell. (By courtesy of Prof. W. M. Davis.)



Bottom of the pot-hole in which the Cohoes Mastodon was found. James Hall with hammer in hand.

traordinary malformed dentition and above all for its mode of preservation:— the bony remains of a carcass floated down in the high postglacial waters and caught in the eddy of the great pit. The skeleton, buried at a depth of about seventy feet, was exhumed and presented to the museum by the president of the company, Mr Alfred Wild. In the delicate work of removing, preserving and mounting these bones, Hall called on Henry A. Ward, of Rochester for help, and in response a young man was sent down from the Ward establishment named Karl Gilbert, one of his assistants, doubly endowed with a zest for natural science and the necessity of making a living. Together Hall and young Gilbert supervised this difficult disinterment, until Hall took a tumble in the deep pit, wrenched his hip, resumed his crutches and left the work to Gilbert alone. Mr Gilbert mounted the mastodon in the Geological Hall and helped to erect within the public eye a palaeontological monument to himself. In this way Grove Karl Gilbert, who was to become a distinguished figure in philosophical geology, made his entry into the science. Soon after this we find Gilbert restoring the missing tails for the Irish Elks in the museums at Albany and Columbia, but we catch a better glimpse of the trend of his real interests in the study which he made, to arrive at the geological age of the Cohoes mastodon, based on the rate of retreat of the

shale cliffs of the Mohawk valley under the complicated processes of weathering. This he did by cutting off projecting cedar roots from the cliff faces, counting their growth rings and establishing a ratio between the length of the root and the age of the tree; the former factor representing the minimum amount of retreat of the cliff face. It was a novel and clever calculation and it was published with Hall's elaborate account of the mastodon and its surroundings in the report of the Cabinet. The Cohoes skeleton was a fine acquisition for the new museum, for next to the great skeleton taken by Dr. Warren from the bogs of Newburgh, N. Y., it was then the best of its kind, while its mode of preservation was and remains unique.

The very first act of the new Curator of the "Cabinet" was the acquisition of Dr. Augustus A. Gould's collection of recent mollusks and this act was a demonstration of Hall's devotion of his influence to friends in need. Though the merit and worth of the collection on which Dr. Gould had based his lifetime researches were high, yet to a scientific museum seeking to commend itself to public interest, it lacked everything of conspicuous character. But to this friend and counselor of long years Hall and his work owed much. Again and again Gould's advice, his rebukes, his encouragement had served to keep the excitable and erratic geologist true to his objective. Doctor Gould died

in the autumn of 1865. The two had been together in the summer at Northampton for the meeting of the American Association, and among the last of his letters is one filled with that unfailing counsel always so much needed by its recipient, though perhaps too seldom accepted. He writes in part (February 26, 1865), and this is obviously a reply to a cumulative outburst from a man frenzied by some fancied attack of *lèse majesté*:

“I was pained at your doleful view of everything. It is true that the man of Science is likely in most instances, unless he makes Science a *mere trade*, to find his resources scanty and precarious, and his rainy days may be very rainy. So too the state of the country is bad enough, but it is not ruined, nor is it likely to be. Now, my friend, it is of no use, this croaking. It makes yourself unhappy and your friends unhappy and sometimes provoked. The man who persistently and stoutly and even offensively denounces everything about his country, his friends and his science, is not likely to be very graciously dealt with when better times come. The mass of the people is generally right, and why not throw yourself into the current rather than fruitlessly struggle against it? Come, cheer up, keep friends and make friends, and make the end of a useful honorable life grateful. The pursuit of science is itself a reward and a solace which no money can supply the place of. We are too old to quarrel with anybody or to persist in remembering old feuds. We are soon going, and we shall wind up our lives more gracefully and satisfactorily if we can feel at peace with all. We have no further any occasion for rivalry or jealousy. Our seed has been sown, we have labored and sweat through the day, we have garnered our fruits, and

now we have to be content with tribute from our granary and the few gleanings which infirmity will allow. The younger will plant on our ground, and if they can gain better crops, as they ought to, from soil subdued by ourselves, let them do it."

Gould was much loved by his select circle of Boston friends and Hall felt his loss very keenly. He says of him, writing to Miss Gould: "The long years of uninterrupted friendship had endeared him to me as no other friend among my colleagues, always the true-hearted gentleman and the kind-hearted Christian."

The first contributions of notable scientific merit made to the annual reports of the "State Cabinet of Natural History and the Historical and Antiquarian Collection Annexed Thereto," were upon the ethnology of the New York Indians and were prepared, at the request of the Regents, by Lewis H. Morgan. These papers in the early reports were beautifully illustrated in colors and are of intrinsic interest today in addition to the fact that they constitute the first scientific writings by the founder of American Ethnology and the author of the *League of the Iroquois*. "Lewis H. Morgan Hall," in the present State Museum, commemorates not only the distinguished merit of Morgan's work but his interest in the early progress of the institution. In Mr. Morgan's career, Mr. Hall played a helpful part. With a letter from a citizen of

Aurora, N. Y., George B. Glendining, presenting him as a "counsellor-at-law from this place" Mr. Morgan came to Mr. Hall in 1844. He was interested in the Iroquois, historically and as wards of the State (as they were then held to be) and Hall introduced Mr. Morgan to the Regents of the University whom he favorably impressed with a suggestion to contribute to their reports. Following these early contributions, Morgan began his elaborate work on the *History of the American Beaver* to which many of his letters of this period relate. In 1868 Mr. Morgan became a member of the State Senate and in a letter introducing Hall to an influential friend he writes (1867):

"It gives me much pleasure to introduce to you Professor James Hall. He has, out of sheer devotion to the scientific interests of the State, consented to take charge of the State Cabinet of Natural History and Geology in the hope that a new impulse might be given to these collections and to the scientific interests of the State with which they are so intimately connected. You and I know that every dollar expended for scientific purposes is so much saved from the harpies. I know that it will give you the highest pleasure to cooperate with one who has performed so distinguished a work for American science and whose views and plans are entitled to the highest consideration."

We should not pass away from these early days of the Museum without some further reference to George W. Clinton, a member of the Board of Regents. Judge Clinton was devoted to the study of

botany and the collection of the New York flora; in fact he contributed papers of botanical interest to the annual reports. He made the new departure in the Museum a matter of personal concern; he was largely responsible for the engagement of Charles H. Peck in 1866, to work on the Herbarium and he took every advantage of his larger influence to extend Mr. Hall's authority. "Work, then, my friend," he writes (1867), "the fate of the State Cabinet is in your hands—Herbaria, Mastodon and all. Work, and all will be well." But Hall was not disposed to work. Just then, in trying to put through the larger plan for the Museum, something had fallen across his path and he was engaged in telling Clinton about it. Two days after the foregoing letter from Judge Clinton comes another:

"I have no doubt that when your very natural irritation has subsided, you will fall back upon your great qualities and join in putting this great thing through. . . . A man is greatest when, for great public ends, he submits to insult and misconstruction. Time will rectify all those things, and add to his glory."

Miscellanies.

Mrs. Hall and her daughter Josephine, then a charming young woman of twenty, had spent the winter of 1861 in Europe, a country Hall himself had to wait years yet to see. Going and returning

they had come under the watchful oversight of Captain James Anderson, skipper of the Cunard Line sidewheeler "Europa" whose American port was Boston. Captain Anderson was a very remarkable character. Trained to the sea and to navigation from his boyhood he was possessed of an intense love for nature and her works which he pursued with the ardor of a great and devoted heart. His personality was charming; he sought, made and kept friendship with all men of science who traveled on his craft, and his was the craft that such choice spirits sought because of him. In port at Boston, he was at home with Agassiz, Coting, Gould and Dr. Walker, attended the Boston Society's meetings; or when the American port was New York he would go to New Haven to visit the Sillimans and Dana. Murchison and Sedgwick were his friends; Capellini was his ward aboard ship. He loved children and was tremendously interested in the establishment of the Free Museum in Liverpool.

His courtesy to Mrs. Hall evoked a letter of appreciation from Hall to the Captain and this led to a long discursive correspondence which continued for several years until at last Anderson came on to Albany to see the great Palaeontologist and his collections. Together they tramped the Helderbergs, knocking out its fossils, the skipper, filled with a knowledge of the life of the sea, interpreting

the past in the light of the present. Then they visited the valley of the Schoharie, and for some years after Captain Anderson's letters are alive with keen recollections of this visit. He had Mr. Hall's young son Edward gather frogs, toads and pollywogs to exhibit in the Liverpool Museum and for a long time he kept up this exhibit in the name of the boy. These were Civil War days and the Englishman's long letters are rather frankly sympathetic with the South — views which were probably not wholly unwelcome to Hall who was a tremendous "copperhead." When Cyrus W. Field was looking for a competent man to lay the Atlantic Cable he went to Anderson who was then in command of the *China*. He was regarded on all hands as the most competent shipmaster in the English service. "He had long been known to the travelling public both of England and America," says Henry M. Field in his *Story of the Atlantic Cable*, "and no one ever crossed the sea with him without the strongest feeling for his manly and seamanly qualities; a thorough master of his profession having followed the sea for a quarter of a century. He was also a man of much general intelligence and of no small scientific attainments." In 1865 Captain Anderson took charge of the *Great Eastern*, after many catastrophes succeeding in 1867 in successfully laying the Cable. For this service he was knighted and in 1870 Josephine

Hall and her brother Edward visited Sir James in London where he kept a geological museum in his house for which he was ever seeking more fossils. He had now become manager of the Submarine Telegraph Companies to India. "I have 9000 miles of submarine cable and £2,500,000 under my management and this keeps me busy" — but he nevertheless wants more fossils and suggests that some money Hall had borrowed of him in the dark days of five years back might be returned in fossil footprints. On Professor Hall's visits to Europe in 1872 and 1878, these friends saw much of each other (Anderson was then the head of the Eastern Telegraph Company) and for many years after my arrival in Albany, Hall was wearing a gray plaid top coat — then changed to a mouldy green — which Sir James Anderson had given him.

The Civil War.

The dark years from 1861–65 seem to have brought little disturbance to Mr. Hall's scientific work and no readjustments were required except in the increased contract prices for his printing. We have intimated that Hall was not very sympathetic with the aims of the North and though he did not often make his war views the subject of his letters, there were occasional outbursts from him that may as well escape publication. I think this attitude was largely due to the unavoidable disorder that fell

upon the South wherein were proceeding scientific surveys and investigations in which he was deeply interested.

In 1858, Dr. Ebenezer Emmons had left New York and gone to North Carolina to conduct its Geological Survey and the distress caused by the oncoming war, unquestionably brought his death in 1863; his work was suspended and his manuscripts in most part destroyed. Governor Sam Houston suspended the Texas Survey in 1861 and Benjamin F. Shumard, for whom Hall had secured the position of State Geologist, was sent adrift. Swallow writes from Missouri (1862) where General Frémont had put the State under martial law: "They have carried my maps into the army and taken possession of my office and cabinet room for the quarters of soldiers and officers. I know not how much I can save." Safford, of Tennessee, a man of most exceptional qualifications as a palaeontologist and whom Hall had invited to join him in preparing his monograph of the Brachiopoda, writes that the distressing political conditions forbid any thought of the matter. "I trust before long, under God, the dark cloud which hangs over our country may be removed." Doctor John S. Newberry, who had returned from his Colorado Survey and was interested with Hall in the fossil plants of Ohio, abandoned them, promptly joined the United States Sanitary Commission at the out-

break of the war and there remained until its end. On the other hand, in prosperous Michigan an effort was afoot in 1862 to revive the Geological Survey of the State. Alexander Winchell mentions this project to Hall late that year and asks him for endorsement to the Governor which is given cordially and unsparingly.

As far back as 1849, there came to Albany with a letter of introduction from Barrande, an Alsatian named Carl Rominger, a doctor of medicine and a lover of all science. He was from the University of Tübingen and had tramped with Barrande over the Bohemian mountains. He had not come to America to stay but when in his travels he had got as far as Ann Arbor his money gave out and he was obliged to establish himself there in the practice of medicine. In these later years, still intensely devoted to his rocks and fossils, his relations with Hall were renewed and lasted long. Doctor Rominger was later to become the State Geologist of Michigan and to do a work on the fossil corals of her old rocks which has not been surpassed and which stands out by itself among the official reports of that State. He was a gentle spirit with microscopic eyes and analytic brain; of the older type whose names still stand for excellent achievements; and when long years afterwards the venerable Albany palaeontologist, struggling over the intricacies of the fossil Bryozoa, cried out for help

to Rominger, declaring in his bewilderment that he did not care whether "the pesky things were called *Chaetetes* or cucumbers," Dr. Rominger came on from Ann Arbor full of concern for what he called his *Shytaytays*, and stood by in the preparation of the monograph which was to be Volume VI of the *Palaeontology*.

In 1865 Herman Credner, a young geologist of Bonn, came to Hall with a letter of introduction from Professor Roemer and besought him to "help me to get a position suitable for a young geologist." He had come to acquaint himself with American geology in the hope of attaining to a university professorship (as he did eventually at the University of Leipsig) and he presently secured employment in New York with a firm of mining engineers, in the intervals of his time preparing a geological survey and map of New York City which he published in Germany. Soon after Credner was engaged by Raphael Pumpelly to assist on his Northern Transcontinental Survey.

John J. Bigsby sends a cheering word from Portman Square (1867):

"I need not tell you how mightily and how certainly you have advanced Palaeozoic zoology and what a poor display this branch of natural history would make if the sun had not risen upon a James Hall."

When Hall sent out his own and Sir William Dawson's papers on Devonian plants, he received

from the Count de Verneuil a letter of acknowledgment which has some comment of historical interest. It is printed, as written, in the Count's own pater (March 28, 1864):

"Your paper on the Devonian flora is also of the utmost interest, for the resemblances it has with the Carboniferous, but though the genera in both formations are about the same, the species are different, and confirm the conclusions derived from our anterior study of the animal kingdom. This is a very interesting point, as in America you have not great dislocations between Devon and Carboniferous era. In Europe the dislocations pointed out by El. de Beaumont do not exist in many cases. Generally speaking the great epochs of *soulevement* as they were established by El. de Beaumont are in complete abandon. It has been proved that the *soulevement* des Pyrenees referred to the interval of time between the chalk and the first tertiary deposits is posterior to the Eocene or the Nummulitic, but El. de Beaumont has referred to that epoch the *soulevement* of Corsica and Sardinia. If he is right, we have two ridges of elevations quite unparalleled [i. e. not parallel] and contemporaneous. The great principle of El. de Beaumont's theory is then contradicted by the facts. The principle is that the *soulevements* operated in the same epoch or contemporaneous are always parallel. It has been proved that the facts upon which El. de Beaumont had founded his *soulevement* des Alpes occidentales are equally wrong. Mr. Desor has showed that the beds of conglomerate inclined, said by El. de Beaumont ancient alluvions, at the foot of the Alps, are much older and belong to the Miocene Molasse. If so, the western Alps have been elevated at the same epoch as the eastern Alps, and however they affect a very different direction.

I see that in America your geologists do not pretend to classify the ranges of mountains only by their directions. I am convinced that they are right, and that mountainous ranges may have been elevated at the same epochs though they have not the same strike."

Mr Whitfield, who had come to Hall as a draftsman, had rapidly developed into an investigator and was growing uneasy over the restraints of his position. In 1865 he applied to Dr. Newberry at Columbia College for association with him and Hall began to look about for someone else to illustrate his publications. F. W. Putnam suggests that Hall try to get a fellow student of his at Cambridge, Edward S. Morse of Gorham, Me., and Hall (1865) offers him the position, which is at once accepted; but Morse has scarcely given his assent when he receives an offer of the professorship of Natural History at Bowdoin College and is obliged to ask his release from his promise. One can but wonder what might have been the course of palaeontology in America had this brilliant spirit brought his skill and vision to its service; or what would have been the loss to America in its knowledge of Oriental ceramics; what even the fate of his important researches upon Brachiopoda, with which he was then engaged and of his spectacular demonstration that they are worms; of which interpretation he soon writes: "Professor Steenstrup of Copenhagen endorses my brachio-

pod views and tells me he has taught them to his students for a long time."

Professor Hall's relations with Edward Orton seem to have originated in 1867 while Orton was stationed at Antioch College, Yellow Springs, Ohio, in an effort to bring together a collection for that institution. The next year Hall endorses Orton to the Governor of Ohio for a position on the new Geological Survey under Dr. Newberry. Orton writes to tell Hall that his letter was effective and his appointment has been received: "I recognize my obligations to you and will be glad to pay them if you will allow me a chance to do so." And a little later, when Hall is complaining of ill health: "I sincerely hope that a vacation will restore you to a place that no one else can fill." It is a long reach from these beginnings of Professor Orton's important career to its closing labors which were spent in the service of New York.¹⁰

¹⁰ Edward Orton's life was one of singular beauty which greatly endeared him to his contemporaries. Born in the country village of Deposit, N. Y., he entered the ministry and assumed a pastoral charge, and though he afterward thought it well to resign the ministry, it will be remembered by many that to his latest years he wore its badge of office—a white cravat. Professor Orton then became a teacher of science in the Albany Normal School and shortly after leaving Albany removed to Ohio where we find him active in teaching science at Antioch College of which he became president. Thereafter he became president of the Ohio State University and State Geologist of Ohio and in his last year President of the American Association for the Advancement of Science. To his remarkable labors for the State of New York after he had become crippled on one side by paralysis, a later reference is here made.

Sir Archibald Geikie says that in Caithness, along the flat shore reaches of the coast, the roadways are visible for so long distances that travelers approaching each other begin their welcoming smiles while they are yet mere specks in the distance, one to the other, and the smiles grow to their climax as the wayfarers meet and pass. Thus comes the "Caithness smile", which emblazons the countenances of these North Scots. That reminiscent geologist intimates that the broad flat rock strata everywhere yawning on the shores of Caithness may have also wrought in producing this smile. I have heard an eminent scholar who "favors" the Scotch, though himself of the "Heart of America", tell of overhearing in the Edinburgh railroad station one Scot greeting another with the inquiry: "Well, what formation are ye from?" Among Hall's many admirers there was, in 1861, a Methodist minister, the Reverend E. G. Bush, whose various parishes were not in villages but on geological formations. His letters tell of his present residence on the Chemung rocks, but that in his itinerant life he had before dwelt on the Hamilton, on the Catskill, on the Portage, the Marcellus, the Helderberg and on the Tully formations; and wherever he went, along with his bible, his sermons and his family, he took his Trilobites!

CHAPTER X

THE PERIOD OF VOLUME V—1867-1878

I

Volume IV appears — The Geological Map of the Northern States — The "Palaeontology" and the personnel of its workers — A great scientific workshop — Hall's habits of work — His many assistants — Whitfield, White and Van Deloo — Walcott's collections and researches — Beecher's arrival — Callaway, H. H. Smith, Henry Herzer, J. S. Kingsley, L. O. Howard, Fernald, E. S. Morse — Hall and Ramsay on the Old Red Sandstone of the Catskill Mountains — The Sherwoods, T. B. Brooks, Theodore Gill, Ernest Ingersoll, Persifor Frazer and C. F. Holder — Hall lecturer at Cornell University — Other college positions — Chas. Fred. Hartt; his career at Cornell and in Brazil — Intimate side of English geologists — Bigsby's letters — Story of the Cardiff Giant.

THE majestic Volume IV which closed and crowned this decade slipped quietly into existence without comment, at least in its author's letters. The preparation of his "Palaeontology" was now to Hall the proper and normal routine of his life. For it he lived; he did not debate it, except before legislative committees, and then debate was confined to the committee; Hall satisfied himself with demands for appropriations.

This volume IV was an impressive biological monograph of 428 pages and 69 lithograph plates devoted to the Brachiopoda of the Devonian System in New York. It was different from its predecessors in that it dealt with a single biological element of a great fauna, while the others had been concerned with all the elements of a few faunas. For this reason the appeal of the new book was more restricted though it dealt with fossils which were scattered broadcast in profusion over a great area. It was a refined and stable work and its virtue still holds.

Among Professor Hall's hopes, still nurtured at this time but doomed to disappointment, was his projected Geological Map of the United States. He had given to Sir William Logan's great Geological Map of Canada, which included the eastern United States (1868), all the data south of the border, but in so doing he felt, and rightly, that, in taking advantage of an opportunity for costly printing which he could not himself command, he had let himself be eclipsed by the distinguished Canadian. Now that the Logan map was out he turned back to his original purpose. Beyond any comparison Hall was the best equipped man in America to prepare such a map; his personal knowledge was greater and his understanding of the correlation of formations more trustworthy. The idea took various forms at different times, and he went to

Professor Henry with a plan which covered the "northern states" only:

PROFESSOR JOSEPH HENRY

SMITHSONIAN INSTITUTION

April 18, 1868.

Some years since I had several conversations with you relative to the publication of a Geological map of the Northern States, and you promised me the aid of the Smithsonian Institution to accomplish the object. At the same time Prof. Bache promised aid from the Coast Survey relative to the perfecting of the map in its geographical details. Sir William Logan has been for many years preparing a geological map of Canada and adjacent parts of the United States. His large map will be published next month. To this map I have contributed all the materials collected by myself or obtained from other sources, and I have had the promise of the use of the plates for my own map. Now I want if possible to finish it on the same scale, and I would like to know if I can get any help from the Smithsonian Institution affecting both Sir William Logan's map and my own. The great cause of delay has been the unsettled and undetermined state of the geology of New England. Sir William Logan and myself have spent much time between here and the westerly border of Vermont, Massachusetts and Connecticut. In times past I have spent many thousands of dollars of my own means to obtain materials for this work, but increased prices without increased income have prevented much of this work for some time past. I shall be glad to have an early reply if convenient to you, since upon it will depend in some measure my action.

Professor Henry could not assure him very substantial assistance, and as Hall had already taken

up the matter with Bache of the Coast Survey, he now wrote to Professor Benjamin Peirce who had succeeded Bache in the position of Superintendent of that Survey. This appeal was cordially met by Peirce who referred him to Mr. Hilgard "with the assurance that I shall acquiesce in any arrangement which will accomplish the object." The promised help may have been given in the matter of the execution of the base map but what department of state was to defray the cost of printing a great map in colors, of so large a part of the public domain? There was no Federal geological survey in existence and no very obvious direct or indirect route through the Government treasury with so costly a proposition. The time was not ripe; we were too young a people yet, and Mr. Hall was too wise to jeopardize his work in New York by bringing forward so gigantic a project for his own State's support. The great map was never done and all echoes of it soon died away amid the rapid development of the "Palaeontology."

The volume of the Devonian Brachiopoda was the opening door into the vast faunas of the Devonian System of New York which, beginning with this, were now to be exploited in a series of biological treatises. The Devonian rocks cover nearly one-half the area of New York State and their faunas are of unsurpassed richness. Those rocks had been to Professor Hall the most fascin-

ating of all collecting grounds during the days of the Fourth District Survey and now, after thirty years in the systematic course of his researches, he had come back to the fossils he first encountered in their embarrassing wealth. Feeling himself and his work firmly established, he obviously intended there should be no more quibbling or hesitation on the part of the State in supporting his undertaking to its completion. By 1870, and from then on for ten years, work in palaeontology was proceeding in Albany at a majestic pace and the estate on the banks of the Beaverkill was a busy center of scientific research. Whitfield, Simpson, Ebenezer Emmons, Jr. and Mrs Martin were making original drawings, though Mr. Whitfield, wonderful artist in the depiction of fossils, was now largely engaged in the descriptive writing. Swinton, Ast and Riemann were drawing on stone as fast as lithographic stones could be supplied. The lithographic printing was for a while done by Swinton in Philadelphia and then under contract with the Van Benthuyssen house in Albany, but in order to get all his work where it would be under his immediate eye, Hall rearranged two buildings on his estate to accommodate the lithographic printing and there, under the most scrutinizing inspection, often the most fiery and incisive criticism by every artist in ink or crayon who had a personal part in the execution of any drawing, this delicate work of etching and

printing the lithographic stones was carried on by Swinton, Fritsche and Conners. The drawings covered all manner of life in the Devonian fauna; Cephalopods, Gastropods, Pteropods and Lamelli-branches; Trilobites and other Crustacea; Bryozoa and Corals; they were made by scores and hundreds and always with most refined accuracy and finish; otherwise they failed to pass their severe critics. Even though much of the delicacy of detail and beauty of finish in these drawings was bound to be sacrificed to the moloch of the printing press, yet all these excellencies of execution were demanded and their attainment was ever pursued by a heightened competition.

There are names here that must not be forgotten in service to the science of palaeontology. Robert P. Whitfield will remain well known for his palaeontological work in the reports of several of the States; his skill in delineation led him into an understanding of refinements in organic structures. George B. Simpson, the son of Professor Hall's sister, was instructed by Whitfield, and though his work was always endangered by its rigidity and certain want of "moulding," yet some of the drawings of his later years, especially those of the Bryozoa and Corals, are of exquisite delicacy. Ebenezer Emmons, Jr., a son of the Doctor Emmons whose name has been so often on our pages, surpassed all others in genuine artistic ability and

rendering, and I think the most delicate, accurate and effective single drawing ever made for the *Palaeontology* was executed by Mr. Emmons when he was past sixty-five years of age. Of the lithographers, Philip Ast was an artist of extraordinary skill; his equal in such work has never appeared in this country. Mr Ast had the "reversing eye;" reversed his figures in copying on stone naturally and deftly and without any meretricious aids, and the delineators in india ink were ever desirous of his rendition of their work for he smoothed out all their delinquencies. A finished stone by Ast was an object of exquisite beauty. Alas for draftsman and lithographer! In such work their efforts toward delicacy are at the mercy of the acid of the etcher and the ink of the printer.

Mr. Hall took utmost pains to ensure the perpetual quality of the results he so rigorously sought and his printers were of the best. Hence the quality of the final product averaged high. To me, as a young enthusiast in the study of fossils, the making of these illustrations was incomprehensible. It was difficult to believe that human fingers could produce things in a book so like the objects the rocks contained. In after years it became my work to superintend the production of some thousands of such drawings and hundreds of lithographic plates made by these artists, and yet I never ceased to wonder at the skill which made them.

To keep this scientific workshop going, it was necessary to keep men busy gathering, preparing and classifying the fossils and to some of this array of men we shall presently refer. Hall had also to provide the lithographic stones at his own expense and there were sometimes more than a hundred of these with drawings on both sides. And here it is interesting to record that all this work of lithography and lithographic printing was a part of the contract for the printing of the *Natural History of New York*, entered into between the State of New York and C. Van Benthuyssen's Sons in or about the year 1840. For more than fifty years the contract continued in force subject only to changes required to meet the civil war fluctuations in costs, always carried out with most generous consideration of the author, his embarrassments, delinquencies and high purposes, executed with the proper pride of good workmanship and terminated only through the intrusion of a hostile and uncomprehending official charged with brief authority for mischief.

Of all the corps of men engaged upon this work, Mr. Hall himself was, in these days, the most diligent. Nothing that entered into his publications escaped his criticism and review and he was keen and quick in the preparation of his manuscript. Up and at his desk soon after break of day, with a cup of tea and a panada at his elbow, he found his

quiet hours before his assistants came around. And after they had gone there were the evening hours which seldom found him away from his work room. It was his habit when at work to sit before his desk on a revolving piano-stool; his backbone needed no support and an easy chair he abhorred. But alongside his desk he kept, for his callers, a deep scoop-shaped great chair into which the visitor shriveled as he sank down into insignificance near the floor, while his vis-à-vis, erect on his stool, towered majestically over him. It was a strategic advantage and in many an engagement commanded the enemy's works. Just off his large library or "office" was his bedroom — nothing more than a cell with an iron cot, a wash-hand stand, a looking glass, a small table with spirit-lamp and teakettle, and a shotgun on the wall; and if the night was an uneasy one he was wont to sally abroad, candle in hand, among his fossils or to sit at his desk and rid his mind of restless thought. So we were wont to find drops of candle grease over fossils and books, evidences of his nocturnal prowling.

In 1871, Hall was 60 years of age, just at the threshold of his greatest productiveness, his most effective train of assistants still to be organized, his richest harvest still to be garnered. He was always on the lookout for competent but not too ambitious assistants to work out his materials. They came and they went. To those he wanted to remain he

offered temptations, not always effective. Richard Rathbun and Orville A. Derby came in those years to study the fossils they had brought home from the Devonian and Carboniferous of the Amazon and each of them Hall vainly tried to keep. Adolf Schmidt, who had been with Raphael Pumpelly in his Northwestern Transcontinental Survey, and Reinhold Fritz-Gaertner, who left an engagement in England, came for a few years, but they had little interest in palaeontology and they passed out, Schmidt to become professor at Heidelberg and Fritz-Gaertner geologist of Honduras. Hall's younger son, Charles Edward, was for a while assisting in this work. "Ned" was a good geologist and was afterward connected with the surveys of Texas and Pennsylvania, finally going to Nicaragua. When he left, his place was taken by his older brother James, who was not only a good collector and fine preparator but, as a doctor of medicine, had a knowledge of anatomy which was helpful in his father's researches. The collecting done for these investigations could not be carried on in a mincing way. Hall taught his men not only the science but the art of collecting fossils. When R. P. Whitfield and Charles A. White, in 1857, located the remarkable colony of crinoids at Muttonville (Vincent), Ontario County, in the Hamilton (Devonian) shales, they with Christian Van Deloo, collector, removed a whole hillside in order to get

all there was to get, and I am witness of the fact that no traces of these remains have been seen there since. Mr. Van Deloo was an extraordinary collector and during the years of which we are now speaking he was employed in magnificent operations among the invertebrate fossils. He was the forerunner of the great collectors who have developed with the opening up of the palaeontological treasures of the American West. In 1876, Charles D. Walcott, an indefatigable student who had made his start in the rich Ordovician formations, the Utica shale and Trenton limestone of the upper Mohawk valley, joined Mr. Hall's staff of workers. Mr. Walcott was more than a collector; he had proven himself a keen discover of new things in the rocks about his home region at Utica. The trilobites which he had found in a small ravine just east of Trenton Falls were like carvings in polished ebony and are still unsurpassed for their extraordinary brilliancy and completeness. They had led him into the quest after their intimate anatomy, a problem over which every student of these creatures had puzzled, Burmeister and Barrande and Woodward among others. To help himself in the solution of this problem. Mr. Walcott had gone to Cambridge for advice and guidance from Agassiz, and in a recent article (1918) the now distinguished Secretary of the Smithsonian Institution has said:

“In September 1873 I said to Professor Louis Agassiz that if opportunity offered I would undertake as one bit of future research work to determine the structure of the trilobite.”

And after forty-five years his researches and discoveries, based upon vast collections, have never relinquished the solution of this mystery. It is now in large measure resolved for the earlier and more highly specialized branches of this extensive group and the result stands as a remarkable evidence not alone of the refined retention in the fossil state of the most delicate anatomy, but, as well, of persistent effort in unraveling these structures from their difficult surroundings. Mr. Walcott came to Albany to assist in the collection and the classification of fossils, but, by a specific understanding with Hall, he was to have no part in the preparation of the reports; on the other hand, he was to publish his own discoveries, over his own name. And during his three years stay with Hall, Walcott collected actively, especially along the Devonian coral reefs of western New York, while in the same time he prepared and had printed in the State Museum reports and the Transactions of the Albany Institute, several papers on his discoveries among the trilobites and other fossils in the lower rocks which held his special interest; indeed his first attempts to reconstruct the trilobite appendages from transparent sections of the curled-up trilobites of the

Trenton limestone were set forth in the reports of the Museum. Hall had never before made such a concession as to permit an assistant to publish independently in his reports upon the geology of New York and it was an arrangement bound not to continue long, though it was kept in perfect amity and mutual helpfulness, for Mr. Walcott was a young citizen for whom a member of the Legislature had no terrors and he did not refrain from personally urging among these members a sane public support of Hall's researches. On the other hand Hall, quick to perceive promising genius, supported Walcott's undertakings and his promotion to the newly organized Geological Survey of the United States under Major John W. Powell, whither Mr. Walcott went in 1878, eventually to succeed to its directorship.

In the summer of 1873 there came to Mr. Hall's laboratory a tired boy, knapsack on back, who had been collecting fossils all the way across the State from Lake Erie. He had come most of the way afoot to see the great palaeontologist and to show him the fossils he had found. Hall, the author of the *Palaeontology of New York*, had been to him a superior being to whose books he owed the inspiration of boyhood days among the rocks of Fredonia on Lake Erie and the gullies and hillsides of Warren, Pa. This was Charles E. Beecher, and with his coming there dawned for Hall days of happi-

ness as well as days of tragedy. Beecher was a boy of seventeen, full of ardor for the fossils in the rocks and the shells in the streams. Hall took in the weary lad, refreshed and fed him, showed him his great collection and all the wonders of his place. Keen, perceiving and quick to stimulate a budding devotee of his science, he encouraged Beecher to go to college and to keep in touch with him. Beecher entered the University of Michigan in 1874 and through his college course wrote letters that are models of respectful deference and intelligent comment. Hall became enamored of the boy and in the summer of 1875 went out to Beecher's home at Warren in western Pennsylvania to see his collections and to visit his localities of Chemung and Carboniferous fossils. After surrendering an ambition of going around the world on a scientific expedition which was projected in 1877 — a rather necessary surrender, as he could not find any one to advance the required \$2,500,— Beecher reminded Hall of his promise to find employment for him and Hall, thinking that the young man ought to consider a future that would be free of the uncertainties which attended his own work, recommended him to a vacant position in the teaching staff of Williams College. "If I should be so fortunate," wrote Beecher, "as to obtain a position at Williams I think they would find me more willing than capable." It was obvious that he wanted

to come to Albany, equally plain that Hall wanted him, and in 1878 it was so arranged. Hall went to Europe in July, Beecher came in August and is soon writing to Hall in Paris: "So far I like it here very much and hope I may be of sufficient assistance to remain." Mr. Beecher remained ten years.

While in England in 1872, Hall had met an independent enthusiast in geology, Charles Callaway of Shingleton, who desired to join the Albany establishment for the purpose of acquainting himself with the New York rocks and Hall's methods of investigation. Mr. Callaway came over in 1873 and remained two years, in this time taking some part in collecting for the Museum as a goodly number of the Museum locality records for these years indicate. Mr. Callaway was not an expert in palaeontology but afterwards, in his long years of geological service terminated by his death in 1915, rendered very substantial contributions to British geology, especially in his labors on the Cambrian formations. His name is registered in British palaeontology by the trilobite genus *Callavia*. Mr. Callaway was 34 years old when he arrived in Albany; he was much interested then in the educational side of his science and the bent of his mind is, in a way, indicated by an address he delivered before The Albany Institute (1873) on the "Geological Evidence of the Origin of Species by Evolu-

tion." Mr. Hall held Callaway in high regard and when Alexander Winchell became the Chancellor of Syracuse University, recommended him as professor of geology there. "He is a graduate in science of the London University," he wrote, "and I do not know any young graduates of our own institutions who are as competent as I consider him to be for such a position" (1873).

Herbert H. Smith, a student at Cornell with Professor Chas. Fred. Hartt and who afterward became well known for his scientific explorations in South America, was connected with the staff of collectors at various times during these years¹ and Whitman Bailey, a brother of Loren H. Bailey, Provincial Geologist of New Brunswick, made a brief stay in 1874. We find Hall asking Bishop Havens of the Methodist Episcopal diocese of Ohio, to release the Reverend Henry Herzer, a minister of that denomination, for service at Albany. Mr. Herzer is still well remembered as a collector of unusual skill and productiveness and the discoverer of the great fishes (*Dinichthys*, *Titanichthys*) from the Upper Devonian shales of Ohio. The consent of the Bishop was obtained but Hall's offer was not enough for a man with "one-half dozen children," two in college. "As a preacher," he adds, "I can

¹Dr. Smith, born at Manlius, N. Y. in 1851, and in 1919 curator of the Museum of the University of Alabama, was killed by a train on March 22nd of that year.

get anywhere \$800 and free rent and in some places \$1,000 and a house. The position I shall very likely obtain by next June will secure me a fine residence, all my necessary provisions and \$600 salary. I will be Principal of an Orphan Asylum." With such an alternative, science, which in Albany was largely compensated in love and opportunity, could not compete.

Of the others of these years who wanted to join Professor Hall there was J. S. Kingsley who began sending in fossils for determination, he says, "in 1867 when I was 13 years of age," and who in 1876 begged for a position because the Peabody Academy at Salem, with which he was then connected, had "run into debt, Dr. Packard, Caleb Cooke and the janitor being the only paid assistants." This eminent American zoologist, it appears, started his career in science, collecting fossils from the Devonian rocks about his home in Chenango County, N. Y. In 1876 Professor Hall received a letter from Samuel G. Williams of Cleveland who had been a high school teacher at Ithaca and was to become a professor of pedagogy at Cornell University, recommending to his notice a promising junior in the college by the name of Leland O. Howard. The efficient present head of the United States Bureau of Entomology and Past-President of the American Association for the Advancement of Science was immediately sought out by Hall to

see if perchance he would fit the requirements of his work. Mr. Howard was quickly responsive but the connection failed and a possible palaeontologist was allowed to become a very positive entomologist.

One other member of this scientific community for a while was C. H. Fernald, in after years an entomologist of excellent service in the Maine State College at Orono and the Massachusetts State College at Amherst. Mr. Fernald had been recommended as a draftsman by Edward S. Morse of Portland, Me., who had found it impossible to join the Albany staff, but Hall thought Fernald would serve him better by collecting the Devonian fossils of Square Lake and Ashland in northern Maine, and here in intervals he was engaged for a few seasons, meanwhile teaching school and selling subscription books.

For many years Hall had been worried over the problem of the Old Red Sandstone in New York. Its presence at Blossburg, Pa., had been one of his earliest determinations in the Fourth District Survey and by inference the entire mass of the Catskill Mountains had, by general consent, been assigned to the same age although the term "Catskill Group" avoided any definite commitment on the part of the geologists except as to its topmost place in the series of New York Formations and as early as 1844 he had satisfied himself, by personal examination, that the Catskill beds contained the same

fish remains as the "Old Red" of Blossburg. Hall had repeatedly and generously stated that Amos Eaton was primarily responsible for recognizing the Old Red in the Catskill mountains.

When Sir Andrew Ramsay was in Albany in 1857, full of knowledge of the Scottish Old Red, the two traversed the Catskill sections together and Ramsay confirmed Hall in his interpretations. Soon after this Colonel Jewett, whose opinions were quite generally respected among geologists, explored the mountains, collected Chemung, that is marine Devonian, fossils from their high elevations and so thought himself justified in declaring that there was no such formation in that region as the "Old Red." Hall wrote in 1870 that "a denial of the existence of the Catskill or Old Red Sandstone in the State of New York was the prevalent opinion;" and he set himself to determine this matter. In 1871 he engaged Andrew Sherwood and his brother Clark Sherwood of Mansfield, Pa., to map in detail the extension of the Catskill or Old Red from its characteristic outcrops in northern Pennsylvania into the Catskill mountains and adjoining regions to the west and he had these men busy on the problem for four summers, paying a good share of the cost out of his own pocket. These men were thus very active additional members of the Albany corps though not spending much time in the Albany office. The results of their work

were of high importance as shown by Hall before the Detroit meeting of the American Association in 1875. They showed, 1) that the extensions of Old Red north from Pennsylvania lay in a succession of broad NE synclines; 2) that the valleys of the mountain region were carved on subsidiary anticlines which being cut down into the Chemung rocks had led Colonel Jewett astray; 3) that the marine strata on the western side were interlaminated with the red non-marine beds; 4) that the fish beds lay above them but mostly in the lower part of the section, and 5) that the upper 900 feet of gray and red sandstone constituting the summit beds were of the age of the "Vespertine" of Pennsylvania; that is, of Lower Carboniferous age. These conclusions thus recognized the land and delta nature of the Catskill formation, and of its contemporaneous origin with the salt-water Chemung deposits; their interlaminations were interpreted as encroachments of terrestrial sediments on the sea by clearly pronounced diastrophies. The Oneonta sandstone was not as yet discriminated as an opening stage of this deltiform deposit and the recognition of summit beds as Carboniferous has been generally ignored by writers on American geology, though the present writer has had occasion to verify this determination through comparative study of Logan's Bonaventure formation on the Gaspé Peninsula.

Such, then, were some of the activities at Albany during these years. And it is of interest to note further that Major T. B. Brooks, resting from his labors as geologist of Michigan, was deeply engaged with glacial phenomena about his home at Monroe, Orange county; that Theodore Gill and Ernest Ingersoll were promising to report to the director of the Museum on the Fishes and the Birds of New York; and that Persifor Frazer of Philadelphia and Charles F. Holder of New York were seeking positions on the Museum staff.

At the founding of Cornell University, Hall was appointed nonresident lecturer on geology, but he never gave a lecture there, or at least nothing that constituted a course of instruction. In this respect Mr. Hall had learned his limitations and in spite of all his virile enthusiasm and his lucidity in conversation he was not a good public speaker. Presuming too much upon his fulness of knowledge he rarely put his addresses in writing and he was wont to ramble incoherently and ineffectively, to the exasperation and despair of his hearers. Yet his name carried great weight with the new University as long as his wisdom kept him out of the lecture room. In his youth at the Rensselaer School, Hall's lectures had been vastly inspiring, but years of total absorption in his researches seem to have done for him what it has done to many another esoteric, blocked his approaches or calloused his perceptions

of his hearers' capacity. But to be a college professor was not to him a satisfying ambition and it seems evident that he loaned his name to Cornell partly because the ambitious program of the new University had lured into the nonresident lecture-ships such other names as Louis Agassiz, George William Curtis, James Russell Lowell and Goldwin Smith.

When Mr Hall gave his important address on the Evolution of the North American Continent (December, 1868) before the American Institute in New York, as a part in the course in which Silliman, Hunt, Dawson, Horsford and Guyot shared, he wrote out every word he said and by sticking to his manuscript brought himself distinguished credit.

College positions had ceased to attract; and when his old Rensselaer classmate, Dr. Sager of Ann Arbor, urged him in 1872 to take the professorship there about to be vacated by Alexander Winchell, and a trustee of the University of Missouri wanted him to come there where they were looking "for a first-class Prof." for the new Mining School at Rolla, Hall put the proffers aside. But at Cornell, Hall was preparing the way for the entry of a permanent successor. There were many candidates for the attractive position: Clarence King and William M. Gabb; T. Sterry Hunt who did give an occasional lecture, while J. Peter Lesley, at

first strongly urged by Hall, held back, true Philadelphian that he was, for fear of "a too rapid and unwholesome intellectual stimulus" and because the winters at Ithaca were too cold. As Lesley failed him, Hall turned his support to a young Canadian, afraid neither of cold nor heat, who had just taken on a professorship at Vassar College, Charles Frederic Hartt, whose memory is still cherished as that of an inspiring teacher, indefatigable explorer and lovable personality. Dynamic with enthusiasm, Hartt writes to Hall while waiting for the Cornell elections (1868): "To study on the classic ground of New York under the direction of a master in the science is what I long to do." Hartt is now known to this generation as the real pioneer and builder of geological science in Brazil. At this time he had just returned from that country whither he had accompanied Agassiz on the expedition to the Amazon, financed by Nathaniel Thayer, for the purpose of discovering new fishes and determining the existence of an equatorial glacier; for in that day glaciation meant all-world refrigeration. He had come back well loaded with Cretaceous fossils from Bahia, but on taking up his duties at Cornell in 1869, he declares he is going to give up Brazilian geology as soon as these Bahia problems are worked out. The hold was too strong upon him. In 1870 he writes: "A friend outside has given a few

hundred dollars to help finish some of my Brazilian investigations and I am off next summer with several students." And so began the first of the E. B. Morgan Expeditions (1870), the entering wedge of the great service he was to initiate and inspire in that uninvaded treasure house of geological knowledge. The "boys" who went with him on this first trip into the Amazon region were Orville A. Derby,² H. H. Smith, T. B. Comstock and W. S. Barnard. On the second expedition (1871) Derby alone was with him.

The career and influence of Hartt have been the subject of memorials by the distinguished men who had served as his assistants on the Geological Commission of Brazil which he organized; Derby, Richard Rathbun and John C. Branner. Hartt's brilliant and brief career gave to geological science

²Derby was born at Niles, Cayuga county, N. Y. and after his graduation from Cornell became instructor in Hartt's work during the latter's absence in Brazil; was chief assistant in the Brazil Survey, remained in Rio after Hartt's death so that the fruits of that Survey should not be lost, and with the materials collected—the Survey expiring with its chief—established himself as Director of the geological section of the Museu Nacional. In this position he remained from 1879–1891, in the meantime (1886) establishing the Geological Survey of the State of Sao Paulo, the first and only State Survey of the kind yet organized in that Republic. A few years before his death Derby had the great satisfaction of seeing the National Geological Service reestablished, himself in charge, and the vision of his chief take on renewed form. Orville A. Derby was a successful organizer and executive, the largest contributor to Brazilian geology. He seldom came back to America and eventually became a citizen of Brazil. He died in 1917.

much to be grateful for, much to lament; but we can not here follow it far. Our present interest lies in his contacts with Hall, to whom, from the day of his arrival at Cornell, he openhandedly tendered the entire collections of the institution. At his return from the 1870 expedition which had discovered the Devonian of Ereré and Serra Alègre, he besought Hall's advice constantly. "I have a few trilobites from Ereré, Prov. of Pará," he says in first announcing his discovery January 31, 1871, but uncertain as to their age, "Would you have the time to look at them?" Hall thinks they are "Upper Helderberg" and Hartt then admits (February 27) that "in a report published in Pará in which I gave a summary of the scientific results of my expedition I gave it as my opinion that the Ereré beds were Devonian. Before I sent the trilobites I was quite sure that they indicated a Lower Devonian age. * * * I believe you are right in your suggestion" — a very interesting statement in view of the later interpretations of these faunas. The letter following gives a glimpse of Hartt amid the embarrassment of his work at Ithaca.

ITHACA, N. Y., *January 15th, 1874.*

"I fear that this letter will look as though it were thoroly selfish but there happens to be a matter in which a scratch of your pen will aid me in a most important matter and I want to ask you to give it me if you consistently can. It is this: I have spent during the last three years over

\$2,000 of my own money in my Brazilian work. When I came to Ithaca I saw that I could not well begin original work in the palaeontology of this vicinity without interfering more or less with your work, so I have done next to nothing but collect. The Brazilian field was open to me and I went into it. I expected backing by the University but I didn't get it, so I spent my own money, worked like a dog and have finally succeeded in starting a cabinet and in building up a laboratory which I hope you will feel pleased with. But I am terribly pinched pecuniarily and must do something to get out of the mud. I have presented a statement of the amounts spent by me for collecting and am trying to get back at least a part of my money. But I must convince the "bugs" here that my collections from Brazil, especially the palaeontological ones are good for something. Now if from what you have seen of these collections you think that I have done right in making them and that they are really of value to the Univ. you would greatly help me if you would give me a little note to that effect. I beg you will pardon the infliction but I don't know how else to convince our people here that I have done a wise thing.

I am laboring from morning till night with my students. I am drilling them systematically and hope to make naturalists of at least some of them but all will have a little idea of what Natural History work is and will be all the better for the laboratory practise.

Yours very sinc.

CH. FRED HARTT

The pleasant relations between Cornell University inaugurated by President White and strengthened by Hartt were not long to continue. When

Hartt left for a five years' absence in Brazil, Hall was asked to recommend a *locum tenens* and he suggested Orestes St John. But he was not appointed and presently the Cornell influences were aimed at possession of the State Museum and thus initiated an attitude toward Hall and his institution of captious "review" where there should always have been sympathetic cooperation. Such an attitude, of course foreign to the idea of the University, became eventually one of quite personal and very irritating expression but of a sort that time wipes out, with the growing consciousness that knowledge is not wisdom. During these annoying experiences there was an enthusiastic and amiable lover of geology in Ithaca, Samuel G. Williams, whose unbroken friendship helped in a measure to counteract the sapient asperities sown in the college classroom.

Geological Personages

To every geologist touches of the intimate life of the great names in his science have an especial interest. The student who sees the names without knowing the man behind them may magnify them out of due proportion to their human nature and it is good to behold them in working garb. Sir Archibald Geikie has done an interesting service in his happily written biographies of the Founders of Geology and of some of their successors, and out of such a years-long chain of correspondence as

that of Professor Hall's there is much revealed that helps us to feel that our distinguished predecessors were bone of our bone.

We have had occasion to refer to Doctor Bigsby, the British Army Surgeon who, while stationed in Canada, acquired an unbounded enthusiasm for American geology. In the years of which we are now writing, Doctor Bigsby was deeply engaged with the preparation of what he called his "Thesauri," that is, complete lists of the fossils of the different geological ages, tasks of an enormous labor actually far out of proportion to their value to a growing science. Bigsby was already a man of 75, though still full of that British vigor which conceals the years and, it sometimes seems, does not get under full swing until other men have ceased. There is so much pleasant and interesting chatter regarding British and Continental geologists in Bigsby's letters that we give here extracts from them. They begin in 1868 and are written from his home in Portman Square, London.

Sept. 2, 1868. His "Thesaurus Siluricus" is done and the "Th. Devonius" begun.

"Salter,³ the European prince of Palaeontology is in infirm health; Murchison is in Bohemia bad with rheumatism."

³ *John William Salter* (1820-1869). Colaborer with Sedgwick in researches in North Wales, and trained in early life as natural history draftsman to J. de Carle Sowerby. Salter was appointed in 1846 Palaeontologist to the Geological Survey.

Dec. 1, 1868. "I have advanced considerably with my *The Damnoniensis* with the aid of Etheridge⁴ in particular. I know that it is Murchison's wish that he should help me. So will Salter, but he is laid aside by great nervous weakness and variability of temper, the cause and effect of losing his situation at the Museum. * * * I am in my 76th year but pretty hale and in humble easy circumstances. Murchison is 76, Lyell 72-73. The Geological Society of London is flourishing in money and members; Ramsay⁵ is remarkably well, Huxley is getting fat; Carpenter⁶ prosperous domestically; about to bring out some remarkable dredging facts on sea depth and temperature in the Irish seas; Bowerbank⁷ working hard on sponges and producing beautiful developments. We have many very promising young geologists,—Whitaker,⁸ Dawkins,⁹

⁴*Robert Etheridge, Sr.* (1819-1869). in 1857 assistant to J. W. Salter, Palaeontologist of the Geological Survey, with which he was connected for twenty-four years. He was a prolific writer on physical and organic geology.

⁵*Andrew Combe Ramsay*, Third Director of the British Geological Survey (see Archibald Geikie: *Life of Sir A. C. Ramsay*).

⁶*William B. Carpenter*. An extraordinary representative of an extinct race, the "universal naturalist", Carpenter achieved distinction in every field he entered, physiology, medicine, zoology, palaeontology, geology and is to be regarded a founder of the science of Oceanography.

⁷*James Scott Bowerbank* (1797-1877) was the founder of the *Palaeontographical Society*. Perhaps best known for his researches on the sponges.

⁸*William Whitaker*. Best known for his study of subaerial erosion and for his volumes: *The Geology of London*, 1889.

⁹*W. Boyd Dawkins*. A prolific writer on extinct mammals and cave remains.

Holl¹⁰ &c. Rupert Jones¹¹ has his hands full, but a surgeon in London, Parker,¹² is the most rising man by his researches in physiological developments."

May 10, 1869. "Sir R. Murchison has lost an attached wife and is suffering accordingly but bears up as a man can at 78. He is a warmhearted and friendly man. Waterhouse Hawkins¹³ is finding profitable employment at New York. His qualifications are extraordinary and money is of importance to him."

July 6, 1871. "It has pleased Almighty God to allow me within the past three weeks to complete two Thesauri — T. Devonicus and T. Carboniferus. * * * The heroic days of Buckland,¹⁴ Fitton,¹⁵ Murchison, Hop-

¹⁰ *Harvey Buchanan Holl* (1820-1886). When a lad of seventeen Holl accompanied De la Beche, first Director of the British Geological Survey, on explorations into Cornwall and Devon and by him was recommended to H. D. Rogers with whom he worked for three years on the Geological Survey of Pennsylvania. Holl is best known for his researches on the Devonian rocks in South Devon.

¹¹ *Thomas Rupert Jones* (1920-1911). One of the first editors of the *Geological Magazine*; Professor at the Royal Military College, Sandhurst. Best known for his researches on the fossil Crustacea and Foraminifera.

¹² *W. Küchen Parker* (1823-90). Known for his researches upon the Foraminifera in association with T. R. Jones and H. B. Brady.

¹³ *B. Waterhouse Hawkins* is best known for his restorations of extinct monsters made for the Crystal Palace.

¹⁴ *Rev. Professor William Buckland*, Dean of Westminster (1784-1856). In 1819 he was made the first Professor of Geology at Oxford. A philosophical writer of great versatility and learning. "He examined coprolites to discover the food of saurians; he studied snails to explain holes bored in limestone; he extracted gelatine from the bones of the mammoth; he enclosed toads in artificial cavities to determine their tenacity of life and he made living hyaenas crush ox bones to furnish evidence for the con-

kins,¹⁶ Greenough,¹⁷ Wollaston¹⁸ and Sharpe¹⁹ are fast expiring. The kindly Murchison, full of honor, is only half alive, being hemiplegic but working at home his 2 or 3 hours a day with his old zeal. Lyell looks very aged and enfeebles distinctly but slowly. He is 75. Murchison is 79. Lyell is bringing out a new edition of his "Principles." Murchison's "Siluria" has sold well. He is a man of large fortune and large expenditure and is in the habit of assisting young men in preliminary matters. The Emperor of Brazil called on him the other day, which specially pleased a little weakness of the good man. Principal Dawson last spring had a great triumph before the Royal Society in delivering the Bakerian lecture on New Brunswick Coal Plants. Lyell and Murchison were there and complimented him mightily. As to yourself there is not a considerable town in Europe, I suppose, in which you have no friend. Your works are everywhere most highly appreciated."

Dec. 18, 1871. Urges Hall to come to Europe. "If you should think of this the geologists of Europe would be

viction of the old midnight robbers of preglacial caverns." (Robert Hunt.)

¹⁵ *Dr. William Henry Fitton* (1780-1861). President of the Geological Society of London in 1827.

¹⁶ *William Hopkins*, Professor in Cambridge, "led the way in applying mathematical and mechanical knowledge to geology."

¹⁷ *George Bellas Greenough* (1778-1855). First President of the Geological Society of London (1811).

¹⁸ *William Hyde Wollaston* (1766-1828). "A mineralogist of the first water;" "an English gentleman and philosopher."

¹⁹ *Daniel Sharpe* (1806-56). "In all respects a remarkable man." His researches extended to many branches of geology, but most effectively to stratigraphy and palaeontology. He was killed by a fall from his horse.

highly gratified and you would oblige me by taking up your abode in my comfortable but humble dwelling."

Aug. 13, 1872. Hall made his first trip to Europe in 1872 and while Mr. and Mrs. Hall were in Brighton, Bigsby writes that he is not well (at 80) and has engaged apartments for the Halls on Portman Square. "Sir Charles Lyell and Prof. Morris²⁰ live near and Huxley in St John's Wood. * * * I go down to Brighton on purpose to introduce you to our geological friends — not that James Hall of Albany requires introduction anywhere."

May 28, 1874. "Even the slight intercourse possible with you made a friend and comrade of you. We were delighted to look upon the author of so many great quartos. As for me your works have for years been my principal meat. The general impression made upon us was most excellent and upon such persons as Davidson,²¹ Prestwich,²² Jeffreys,²³ Phillips,²⁴ etc. Sir C.

²⁰ *John Morris* (1810–86). Trained as a pharmaceutical chemist, he devoted himself to geology and became professor at University College.

²¹ *Thomas Davidson* (1817–1885). A Scotchman of wealth who was devoted both to art and geology. It is said that he took up the study of fossil brachiopods at the suggestion of Leopold von Buch and this became the principal work of life.

²² *Sir Joseph Prestwich* was born in 1812 and after graduation from University College entered a business career devoting all his leisure to geology. Retiring from business in 1872 he was appointed professor at Oxford. He died in 1896.

²³ *John Gwyn Jeffreys* (1809–85). A conchologist of distinction, expert in Tertiary Molusca.

²⁴ *John Phillips* (1800–74). A nephew of William Smith and assistant to De la Beche on the British Geological Survey. His best known geological writings relate to the old rocks of Cornwall, Devon and West Somerset. Phillips was successively professor at Kings College, London, and Trinity College, Dublin.

Lyell's mind is as clear as ever but bodily he is a very aged man always attended by a lady. He has lost his excellent wife. Her sisters (Miss Horners) live at Florence where they have published a clever book for tourists in Florence. Ramsay and family are well. He is conducting the Govt Survey with credit and in peace. Etheridge has received £150 from the Royal Society to enable him to publish in 3 volumes the Palaeonty of Gt Britain. Huxley & Tyndall are in full swing. Huxley has returned to the use of his razor. Duncan is working hard lecturing on geological subjects. Judd²⁵ is printing in the Qly J^l G. S. L. some interesting papers on the Mesozoics of North Scotland. Rupert Jones is working hard in his usual hunting ground. Barrande of Prague is more active than ever. He is a grand investigator. Principal Dawson's neat and popular "Earth and Man" is in its third edition. Dawson, Heer,²⁶ Carruthers²⁷ and Schimper are disputing on some fossil botany rather unpleasantly. Mr Evans,²⁸ our new president of the Geol. Socy is much liked for his good temper, his great administrative ability and a sufficiency of Geol. Evans is the author of valuable works on numismatics and British antiquities — also a prosperous paper-maker."

²⁵ *John Wesley Judd* (1840–1915). Successor to Huxley as dean of the Royal College of Science, best known for his work on volcanos.

²⁶ *Oswald Heer*, born in Switzerland, was professor in the Zurich University. He was a master of palaeobotany.

²⁷ *William Carruthers*, palaeobotanist, known specially for his researches on the Coal and Cretaceous Plants.

²⁸ *Sir John Evans*. An English gentleman of wealth and a patron of geological science. President of the Geological Society of London, 1875.

Aug. 4, 1875. "I think volcanoes are likely to be a favorite study. Mr Scrope²⁹ employs Judd in the Lipari Islands etc. on liberal terms. Dawkins, Busk,³⁰ Hulke³¹ and others are drawing much attention to Tertiary and other mammalia."

Feb. 4, 1876. "The Geological Society is very flourishing and its papers fairly good, those of Mr Judd being probably the best. Mr Poulett Scrope, a great vulcanist, has lately sent him to Stromboli and to one of the southern provinces of Austria to investigate and describe plutonic appearances. He put £200-400 into Judd's pocket on which to journey. For some years Scrope was blind. He died 14 days ago. * * * Sir Charles Lyell has left a bronze medal for meritorious work. I have imitated him in a humble way and am having a bronze medal struck as an incentive to labour in future days.³²

Dec. 4, 1875. "Ramsay has been raised a step in honor and profit and Judd now lectures at the Jermyn St. School on Geology at £400 per annum. I hope it will soon be £600. The salaries of the younger men in geology are too low but most of them get good jobs as

²⁹ *George Poulett Scrope* (1797-1876). "His 'Considerations on Volcanos' and his 'Memoir on the Geology of Central France' aided greatly in establishing the true principles of geology."

³⁰ *George Busk* (1807-86). In early life a naval surgeon, became interested in palaeontology and made a special study of the Bryozoa. Later his researches extended to the Pleistocene mammals.

³¹ *John W. Hulke* (1830-95). A distinguished surgeon, President of the College of Surgeons, who became high authority on the extinct reptiles.

³² The beautiful "Bigsby Medal" of the Geological Society of London carries on its reverse an engraved replica of the Canadian fossil Echinoderm, *Agelacrinites Dicksoni*.



*T. Huxley
drawn of himself*

Autograph portrait of Professor Huxley before he "returned to the use of his razor." From a notebook used by him about 1857 and evidently made to amuse his baby. (In the author's possession.)



editors or are drafted into the Colonies as teachers and explorers."

Jan. 8, 1871. Replying to Hall's tale of lack of appreciation: "I can understand your feeling of loneliness in the absence of sympathizers. If there are none in Albany there are thousands scattered over the civilized world, and you stand alone in opening out many of the mightiest works of God, just as the Cedars of Lebanon stand alone. * * * Don't give way to depression. Believe in Jesus and be happy. Continue to adorn with new labours the imperishable name you have won."

Aug. 17, 1877. "Ever since I had a slight attack of paralysis I cannot dine at the [Geological Dining] Club in spite of the great friendliness of the members. There are some good talkers at the Club but none equal to Stokes,³³ Buckland, Chambers and Fitton. Robert Chambers³⁴ made the fifth husband to an excellent lady. She died in a year or two and he soon followed. Being 85 complete I see only little company. That admirable geologist Prestwich is professor at Oxford but his class consists of 8-15. His defect is his manner. * * * Your isolation in Albany is not pleasant but indispens-

³³ *Charles Stokes* (1783-1853) was a member of the Stock Exchange. "Careless of fame he labored indefatigably to advance science."

³⁴ *Robert Chambers* (1802-71). In 1844 "there was published an anonymous work on the 'Vestiges of the Natural History of Creation,' a work in which the sincere desire of the author 'was to give the true view of the history of Nature, with as little vexatious collision as possible with existing beliefs, whether philosophical or religious.' Needless to say, it not only created a sensation and went through four editions in seven months, but it also raised a storm of opposition. The authorship, long surmised to be that of Robert Chambers, was not publicly announced until 1884."

able. All great work is done in solitude and the indifference of neighbors. You have been magnificently favoured and will be known for ages to come as the father and creator of a new science — all sublime."

Oct. 22, 1877. "I am 85 full, but as I know where I shall soon go I am content and happy. * * * I congratulate you on being immortalized as the High Priest of American Palaeon'y."

Mar. 5, 1879. "My gold medal has just been awarded to Cope, the reptile-describer, a very good award. Our Lyell's medal goes to Hébert of Paris, Wollaston's to Studer of Switzerland and Murchison's to McCoy⁸⁵ of Australia.

July 15, 1879. At 86 years and 6 months Bigsby is working eagerly at his "Thesaurus Permianus."

Nov. 27, 1879. His last letter. Bigsby is now 87 years old and is still at work. His life stretched over almost exactly the same span of years as Hall's. He writes: "Having had a pleasant and good life and having a happy trust in my Saviour I am ready to depart."

The Story of the Cardiff Giant

Amid distinctions and in spite of constantly making such trouble for himself as he could not borrow, Hall had until now been wary enough not to deliberately put his foot in a trap. But his time had come, and in these years he abruptly achieved

⁸⁵ Sir Frederick McCoy (1823-99). His palaeontological labors with Sedgwick brought him early distinction. Afterward he became professor in Queen's College, Belfast, but in 1854 went to the University of Melbourne and eventually attained recognition as the leading naturalist of Australia.

a notoriety which in the public mouth long overtopped all his scientific honors. When I came to Albany my colleagues cautioned me that it would be wise not to make any inquiries of Mr. Hall as to his acquaintance with the Cardiff Giant. I certainly entertained no such intention, for this splendid humbug lay back of my recollection. It is said that P. T. Barnum gazed upon the silent form of this Stone Goliath, this "lapideous enigma," when on exhibition in the Apollo Hall, New York, "with admiration beaming from his face," at the audacity which conceived and carried off so stupendous a hoax. A more uproarious farce was never launched upon the credulity of a humbug-loving people and seldom has the press had opportunity for such fun with the "apostles of slippered erudition" as in the autumn months of 1869 when the great stone fellow was born back of William C. Sewell's barn in the village of Cardiff, in Onondaga county. Seventeen years had passed before I came upon the scene of its antics in Albany, but the laughs which had been excited throughout the community by the jocose sallies of the junior editor of the *New York Tribune*, White-law Reid, were still echoing on the Albany streets.

The Cardiff Giant, a gypsum man, ten and a half feet long, nude, virile and unabashed, dug up in the dark of an October night in Onondaga county (the same county which produced the bogus "Pompey-

Stone," with its date of "1589," acclaimed by historians for two generations as the earliest record of the white man in these parts of America), warmed the community at once into an ecstasy of learned speculation and casuistry, to the immense profit of its proprietors. While it lay in the pit out of which it was dug, this male sphinx behind Newell's barn became the mecca not more of the unlearned than of the knowing; anatomists and sculptors, geologists, historians and the cognoscenti at large. The "Giant" was hardly "cold" before Doctor John F. Boynton wrote to Professor Henry Morton, of the University of Pennsylvania, full particulars of the "grand old sleeper" whose "chin is magnificent and generous," whose "eyebrow is well arched," whose "mouth is pleasant, the brow and forehead noble" and who on the whole "reminded him of DeWitt Clinton," though the Doctor discards the supposition that the creature had ever passed from life into limestone! Indeed, by the sophisticated the idea that this majestic simulacrum had ever been instinct with life was promptly dismissed as highly unlikely! Spencer F. Baird, writing from that dignified seat of science, the Smithsonian Institution, said the "petrification theory" was "too absurd." Erastus D. Palmer, the eminent sculptor, declared it "a veritable statue" (as indeed it was); and when the guileless petrificationists pointed to the skin

pores out of which the giant's bristles sprouted, as conclusive proof of their contentions, the proprietors, with a wisdom born of the earth, invited distinguished and competent adjudicators to pass judgment on this weighty difference. Henry A. Ward of Rochester and Lewis H. Morgan, founder of American Ethnology, came as experts on anatomy and archeology and from Albany went a distinguished board of survey — the Chancellor of the University, the Secretary of the University and the State Geologist. On their arrival, the tent behind the Newell barn was cleared of paying visitors and the party were "left to their undisturbed investigations for a full quarter of an hour." The wise Chancellor Pruyn saw the lure and was inscrutable; Secretary Woolworth was gravely impressed by this probable creation of the Jesuit Missionaries, while Professor Hall, solicited for an expression of opinion, was content publicly to state that "it is the most remarkable object yet brought to light in the country and although perhaps not dating back to the Stone age, is nevertheless deserving the attention of archeologists." If the story had ended here it might have been with propriety to all, but the career of the Onondaga Colossus had only just begun. Captivated by his unembellished charms the savants of Albany who were charged with the custody of the Geological Hall invited the calcareous humbug to a railed-off exhibition place, rent free,

in the lecture room of this State building, whilst in the learned sessions of the Albany Institute they solemnly diagnosed his claims to recognition. The gate receipts were enormous. Whatever in after years may have been the traditions of Professor Hall's connection with this stone fellow, he was in fact shrewder than all the other "experts," for under cover of the tent at Cardiff he had slipped out his geological hammer and knocked a piece off the giant's anatomy; enough to enable him confidently to say that the rock out of which it was made did not come from New York State; which was the very truth itself.

With this debut into the very best society the Giant, glowing with his Albany credentials, went on to New York, where to the horror of his owners and perhaps to his own imperturbable delight, was already on exhibition in "Wood's Museum, formerly Barnum's;" the only and original 'Onondaga Stone Giant.' "Beware of Imitation Giants," shouted the proprietors as the man from Cardiff came down the Hudson to enter the Apollo Hall. A thousand dollars they would give if the "Albany showmen" could prove the assertion that theirs was not the simon-pure and only original Giant. Thus the "genuine relic" and his counterfeit held their levees in show houses on Broadway only two blocks apart, to the exquisite delectation of a public that dearly loved so audacious a swindle.

Little by little the story came out, run to earth by Professor O. C. Marsh, with the help of the man from Fort Dodge, Ia., who, dissatisfied with his share of the profits, declared that he "got up that giant" from a block of Iowa gypsum. It was shipped to Cardiff, hauled by night to its burying place and resuscitated with full attention to all necessary details. While it may be said that this preposterous object became no less a sensation after it had been proved a hoax and continued on its conquering career until the public grew weary of it, it left behind in New York a train of damaged reputations, while the profane crowd only laughed at the demolition made by this rock-hurling Titan."

First trip to Europe — Visits with scientific colleagues — T. S. Hunt and the Quebec group — Personal relations with State Surveys; Michigan, Maine, Missouri, Pennsylvania — A Devonian Forest in New York — Legislative modes — Sale of Hall's collection — Relations with the American Museum — Legislative and personal relations — Ramsay, Nicholson, Swallow, Frederick Starr, Charles Wachsmuth, B. E. Walker, David Boyle — "Illustrations of Devonian Fossils"—Opinions of Desor and Barrande.

First European trip.

IN 1872 Hall made up his mind to go to Europe. He had longed to go; his standing among his colleagues there was assured and they had long been urging him. But he had spent his money so freely on his work, his great collection and his expensive family that he never felt he could afford himself the trip. Now he was 61 years old and he had just succeeded in selling to the University of Pennsylvania, through Lesley who was Professor of Geology there, a slice of his collection for \$10,000. So he had the money and he resolved upon this vacation. Mrs. Hall and the children had gone over in 1868 and spent the winter with Geinitz in Dresden, thence to Switzerland where Edward, the younger son, was put in school and now they had returned full of messages and invitations.

His long time friend Ferdinand Roemer, who had visited him in Albany in 1845, was persistent in urging him. "I have always been hoping you would pay a visit to Europe and I still hope so," he wrote in 1871. Others had been pressing him, as we have seen: Desor from his chalet, "Combe Varin," in the Jura; De Verneuil and Hébert from Paris and the whole circle of British geologists. Murchison and Lyell were growing old, he must go soon if he were to see them, and the Geological Society of London was to meet at Brighton, the home of his friend and fellow brachiopodist, Davidson.

Desor writes:

Combe-Varin, Canton d. Neuchatel

11th August, 1872.

My dear Professor Hall:

On my return to this place from an excursion in the eastern Canton I found a letter from Mrs. Hall dated Albany 26th July. I was somewhat surprised at it supposing that Mrs. Hall was still at Munich. Now that she has returned to Albany, it is but fair that you should have your turn, and I am delighted to hear that it is going to be so, and that I shall at last have the pleasure of seeing you at my chalet and making to you the honour of the Jura, for you know that I am residing almost on the top of one of its ridges.

Now the question rises how and where are we to meet? To answer this it is proper that I should say something about my own plans. It will not be possible for me to meet you in England, having to attend on the 18th and 19th of this

month the Swiss Association for Natur. Science at Fribourg. On the 20th I shall start for Brussels, when the Anthropological Congress is going to meet on the 22nd. Now supposing that you should like to spend a few days at Paris, after the meeting of Brighton, could you not arrange things in this way that you should meet me at Brussels about the 22 and make with us the excursions which are proposed and which will be, I have not the least doubt, most interesting to you? I hope they will show us the most decisive proofs that *Ursus spelaeus* and Mammouth have lived together with the prehistoric man. If this programme should suit you, then we would after the Congress return directly to this place in order to have chance to study the stratigraphy and orography of the Jura before the autumn prevents us from running about. I feel confident that a stay of a few weeks at this height (3000 ft.) with some interesting objects to look at, and with a good glass of wine to comfort you, will do more for the restoration of your health than any medicine or bathing.

That I will be most happy to receive you under my modest roof, you feel I dare say no doubt. We have so many things to talk about and so strange things too, that I am quite impatient to see you.

If you wish to write a few lines, pray address them to this place, so that they may reach me about the 16 or 17th inst.

Yours truly

E. DESOR

We have but few glimpses of his experiences on this trip. He started in the autumn and made the round of his friends and we can imagine the long reminiscences with Desor over days in America, those days when, as Desor himself put it at this time (1872): "I had to suffer from the coalition

of ambition and perversity during my stay in New England;" and after his guest has left Combe Varin, Desor writes to tell him:

"How happy I am that you did get along so nicely and that, in spite of the weather you enjoyed your Alpine trip. I feel assured that this excursion however shortened will leave you an everlasting impression. It is the peculiarity of the Swiss Alps to impress the mind more than anything else, more than the Ocean, the Niagara, the desert.

Pray give my best regards to my friend Prof. Geinitz. Tell him he must come to have his tree in the avenue.¹ I shall write soon to him. Meanwhile I send him today a copy of my first article on the Congress of Brussels, for his Review."

Yours truly

E. DESOR

One of the visits had a special bearing on Hall's work at home. When in London at the Jermyn Street Museum of the Geological Survey he saw much of T. Rupert Jones, an indefatigable worker on the groups of the diminutive fossil Rhizopods and Entomostraca. Jones afterwards refers to their meeting as "that delightful Entomostracan day" — just as delightful no doubt as an "elephant day" would have been to souls content only with the more obvious. Hall then proposed to Jones to collaborate with him in preparing an account of the Entomostraca of New York. Professor Jones was

¹ He planted a tree in the name of each of his distinguished guests. Hall was to have his later.

very willing but Hall never carried out his part nor ever published an account of these fossils. Singularly enough Professor Jones did have the opportunity many years later to revise and determine many of the New York species and his interest in them was so warmly appreciated at Albany that Jones eventually made over to the State Museum all his extensive accumulations of specimens, notes and manuscripts on this group of crustaceans.

T. Sterry Hunt and the "Quebec group" again.

The relations which had grown up between Hall and T. Sterry Hunt during the active years of Logan's Survey of Canada had been intimate and governed by mutual regard. Hunt was the versatile and brilliant genius of that Survey, and though not pretending to a refined knowledge of geological science, he had unquestionably carried the study of terrestrial chemistry farther than any one of his time in America. The extraordinary excellence and suggestiveness of his researches were exemplified in his "Chemical and Geological Essays," a book which had no equal in the English language. In Logan's work on the difficult problems of the Laurentian, Hunt's aid was of great importance. Much progress has been made in geochemistry and geophysics during the past two decades and it has been somewhat the fashion to speak lightly of Hunt and his work. The vagarious philosophies

of his later years should not impose any shadow on the achievements of his prime.

In the years which directly followed Logan's retirement from the Canadian Survey there was a plan projected for a mining school in connection with the Survey. "Sir William," writes Hunt in November, 1869, "now that he will be free from any responsibility therein, takes much interest in the scheme and will present the school all his books and instruments in all valued at \$6,000." In this school Hunt was to have a part which seemed to gratify him because the new regime in the Survey had obliged him "to resign my little lectureships at Quebec and here [Montreal] and I still get only \$1,600 a year."

At that time Hunt was much in Albany and he was not without tender leanings toward Hall's younger daughter, Anna. He was a skillful lecturer and very much sought for in the States, his appearance in the Cooper Union course in New York in 1869 where he lectured on "Mountains and Valleys," having drawn "an audience of 2,000 people," and his lectures at Cornell University were highly acceptable.

Hunt took an adjutant's part in the exacerbating discussion over the "Quebec Group" and Hall was explicit to him in setting forth his own attitude in the matter. The following letter from Hall to Hunt has historic interest:

MY DEAR HUNT: * * * ALBANY, *June 29, 1872.*

The truth is it was Sir William's pertinacious obstinacy which prevented the acknowledgment of the Primordial character of the fossils [the trilobites of Georgia, Vt.] long before Barrande had written to me as he did Billings and insisted upon the correct view being taken. I wrote and spoke to Sir William again and again but all to no purpose. From the beginning of my examination of the Quebec Graptolites I called his attention to the fact that they were all of different species from ours here in the Hudson River Group but it had no effect. He sent down collections of Graptolites from the Marsouin which I at once recognized as identical with ours at Albany, and I called his attention to the fact. There was reason enough for him to distrust his determination of structure but any suggestion of this kind was met by him in his usual positive way.

When I had completed the description of the Georgia Trilobites I wrote a paragraph showing their similarity to those of the upper stage of the Primordial and suggesting as an only explanation (consider the structure given by Sir William as evidence) that these had lived at a later period. So convinced was I at that time, spring and summer of 1859, that those should be regarded as of Primordial age, that I did not publish the paper till I could see Sir William at Springfield. He was then very emphatic in his expression that the age of those slates was not only Hudson River but they were even in the highest part of that group and this not only in the face of my statement of their Primordial character but that of Barrande also. Even at a later date when I had written an article expressing my views to send to Silliman's Journal, Sir William emphatically declared against an admission of anything looking to an acknowledgment of a lower horizon. Certainly when it became necessary to

abandon that ground I expected he would be willing to bear his share of the blame and act like a man. I very well remember that Sir William always maintained the higher position of the Pt Levis beds and in 1854 showed me how the Utica and Lower Hudson River passed below them. * * *

You are right in saying that Rogers and not the New York Survey originated the opinion that the rocks of East. New York and Western Mass. were of the age of Hudson River. It has always appeared to me that it was not Billing's own determination so much as the persistence of Barrande in demanding the recognition of the Primordial character of the fossils as he had done in his letters to me.

I am not very much surprised at what you say about Murchison though it is worse than I had supposed. I know the spirit, for in 1845 I proposed to recognize certain of our rocks as Cambrian and I got a letter from Murchison protesting that such a course would be robbing him. * * *

Now one word about Emmons and the Taconic. It was never an original idea of his. It was Eaton's and both Emmons and myself were taught it by Eaton. I was led to abandon that view from finding that the fossils near Troy, at Waterford and other places on the Hudson were identical with those of the shales above the Trenton limestone in Oneida and Oswego counties.

Eaton's *First Grauwacke* extended to the west side of the Hudson River and was long ago as clearly defined and described as Emmons ever did his Taconic System. Emmons's impossible sections do not add to the value of his assumptions. * * *

Various Geological Surveys and Personal Relations.

The effort made by the friends of Alexander Winchell to secure for him in 1869 the appointment

of State Geologist of Michigan, seems to have started a general outcry among the geological fraternity. There have been few such successful teachers and popular writers on this science as was Winchell, and certainly in that field he was supreme in this country. A native of eastern New York and now with a period to his credit of active service in the State University of Michigan, he felt himself, as he was perhaps right in doing, the logical appointee to the place. But of geological work Winchell had not much of importance to his credit, so we find Logan, Hunt and Agassiz writing to Hall to protest the appointment, the latter urging Hall to take the place himself; and Sanford Howard, a Commissioner for the new Survey, seeking advice upon the matter, intimates that Hall might have the position. And then Hall writes to Governor Baldwin, answering Winchell's appeal for his endorsement, to assure him that though Winchell is a good man the Governor might do wisely to look into the thing carefully and perhaps he might find some one outside the State who would fill the bill. In reality Mr. Hall was much more interested in the advancement of Dr. Carl Rominger to whom we have already referred as having come to him with letters from Baron von Humboldt and Barrande in 1848. For twenty years Rominger had been practising medicine and cultivating palaeontology and he had

long been an intimate and helpful correspondent giving freely, up to this time, of his very refined researches. Hall's influence got for Rominger a position on the Michigan Survey and he soon succeeded to the directorship (1873) which he held on to with a grim determination that survived the Survey itself. Rominger was a gentle, keen, generous and obstinate geologist with abilities of a high order and he gave distinction to his official career by issuing a volume on the fossil palaeozoic corals which was and probably is yet the best book of its kind printed in this country. That he was a palaeontologist did not lessen the worth of his conclusions on the other phases of his work. Hall distressed him grievously by printing a series of plates of corals just as his own work on these things was completed, but he turns from his repudiation of such treatment to write out a recipe for coffee-bread for Mrs. Hall. Rominger gives a pleasant picture of his simple but productive mode of working in a letter of 1878.

"In the quiet way I prosecute my work, with small expense to the State, I find no opposition and everybody lets me go my own course, but I think the case would be different as soon as I would claim assistants and increase of appropriations. Fortunately I do not believe that with assistants I could work more successfully than I do at present, therefore I need no larger appropriations and have in all things my own way, not to the disadvantage of the State."

In Maine also, Hall was lending a hand to Charles H. Hitchcock by personally urging the matter of a geological survey on the attention of the State legislature. The appeal brought forth some fruit as Mr. Hitchcock was invited to lecture before the legislature and set forth the claims of the science and the happy outcome was an appropriation for the undertaking of which he was to be head, the lordly sum of \$3,500 a year being allotted to this enterprise. This was in 1868. Maine still bears witness, in the totally incompetent official knowledge of its geological and mineral resources to the folly of such trivial treatment of important State concerns.

There were at this time too, geological "goings-on" in Missouri. The survey under the charge of A. D. Hagar had not proved satisfactory and there seems to have been such a violent confusion of claims and rights to work done in that State by Shumard, G. C. Swallow and Hagar, that Governor B. Gratz Brown proposed to wipe out their contentions and start afresh. Thus in 1871 there were various seekers for this distinction and through Hall's help the American Association for the Advancement of Science made an appeal to Governor Brown to at least let Swallow print his completed investigations. Swallow writes in November that T. Sterry Hunt "can not get it. You stand the best chance of all but myself. The people are

pressing the Governor to appoint me." But meanwhile this letter came from Forest Shepherd of St. Louis, who says:

"I am a director in the Geol. Surv. of Mo. and at my mention of your name his Excellency Gov. B. Gratz Brown desired me to write you and ascertain whether we can offer you sufficient inducement to take charge of the State Geological Survey now in the hands of Albert D. Hagar. I am well aware that others have endeavored to rob you of your hard earned laurels amid the western rocks and it would give me sincere pleasure to welcome you to the office of State Geologist of the Great State of Missouri with its multitudinous rock formations."

The call was loud; it must have gratified and tempted Hall; but he put it aside and the outcome was the appointment of Raphael Pumpelly who seems to have had the cordial support of the people during his brief incumbency.²

Professor Hall's relations with J. Peter Lesley were always intimate and often interesting. In 1870, Lesley was in the heat of the efforts to organize a new Geological Survey for Pennsylvania, and by virtue of his many geological activities in a variety of private enterprises and his devotion to his State as shown by the refusal to go to Cornell University, he was in position to give effective help to this campaign. He writes this year from the "Office of the United States Railroad and Mining

² Mr. Pumpelly resigned in 1873.

Register" which he was editing at 423 Walnut street: "Our bill hangs in Committee but there is a universal call for the Survey. Genth, Lesquereux, Hodge and Sheaffer will make a strong team." This letter is brilliantly illustrated with hopes and with pen sketches of Appalachian geology, but its hopes failed to come true. In March, 1871, Lesley says: "If we can overcome the opposition of the Phila^a members it [the Survey bill] will pass the house and then easily the Senate. * * * Sterry Hunt writes me that he wants to take the Laurentian and Quebec part of the Survey. That would suit me exactly and you would agree with me, I think, that nobody could do better." The chickens were counted but the eggs failed to hatch. "Our disappointment at Harrisburg," he says a few weeks later, "was very great but we shall work this year to make it right next winter." In the winter of 1872 all enthusiasm submerged and not till 1873 [March 29] does the characteristic message come. "Important news! (1) Mary [his daughter] fell off a stepladder and was severely hurt. (2) State Survey bill with \$50,000 and 6 assistants has passed twice in the House." April 13: "Our legislature is dead, thank God, and the Devil take it. It died in convulsions of folly." Let us watch the fight on to its conclusion. In 1874 Lesley started in again and writes in April: "We are in the thick of it over our bill. Ten Commissioners to appoint a

chief geologist, he to appoint his assistants. The Board to control. The Chief to make a plan. It may pass the Senate this week and the House next month. How it will work in practise I can not tell." Hall writes to advise Lesley not to sacrifice his independence by submitting to a Board of Commissioners but the provision was made and the Survey organized under such Board, and with this start began the Second Geological Survey with Lesley at its head. But Lesley's appointment was not made without a struggle and we find a letter from William A. Ingham, one of the Commissioners hesitating to endorse Mr. Lesley as some of the University men in Philadelphia were opposed and Professor George H. Barker, then at the University of Pennsylvania, speaks of "the Chandler and the Asa Packer influence" as favoring Dr. J. P. Kimball of New York, while another "formidable candidate" was George H. Cook of New Jersey. Mr. Hall wrote pointedly on this subject and seems to have removed all doubt of Lesley's fitness.

Together Lesley and Hall discussed the personnel of the new Survey, and we find them mutually borrowing from each other; Lesley takes Andrew Sherwood, Hall borrows the services of J. F. Carll, the petroleum expert. Lesley thinks of putting in his service S. W. Ford of Troy, N. Y., who had been making important discoveries in the Cambrian of that region. He does appoint young Edward

Hall and at Hall's request promises an appointment to John J. Stevenson, to be effective in 1875. In characteristic fashion Lesley had gone to Europe as soon as his Survey was provided for (1874) and goes again in 1878 for the Paris Congress and he and Hall met frequently on this trip. On this second visit to which we are to make reference again Hall thought it would be a pleasant arrangement if Lesley would join him, whereat he receives this intimation:

1008 Clinton Street
PHILADELPHIA
June 24th, 1878.

MY DEAR HALL:

After writing you and mailing it occurred to me that you ought to know my private plans. I go with my daughter to escape from intercourse with people and to forget the survey. I take her for protection and service. She takes care of me. We travel off the ordinary routes, and have rejected all offers of companionship. By the time I get into the Alps I will be well enough, or rested enough, to see friends. As you say in your letter that you go straight to the Alps, I sincerely hope that you will let me know *where* there, that I may hunt you up, and especially if you and I can have some cozy days of *dolce far niente* at Combe Varin, or the Bel Alp with Tyndall and his wife, and then travel slowly together towards Paris. I am however a very awkward and capricious companion on a journey, very absolute in my will, petulant about details, and in a word as lawless — as I am a slave to rule at all other times.

How delicious it is to spread one's wings broadly and soar and swoop and circle lazily and capriciously at the

instigation of the moment, in rebellion against the whole universe because it is so overregulated, and escape from its daily musts and shalls and shants into solitary air, filled with new, stimulating sights and sounds, to which one does not belong, and therefore bears the load of no relationship!

Such is the experience I got in 1874 and in 1876, and intend to get again this summer. Mary and I have grown to be like one person, thinking and feeling alike in all things, she strong and young, I capable of regaining all of my youthfulness in a week or two at any time. We disappear from society together like twin knight-errants seeking adventures, and refusing other companionship; enjoying every chance stranger; hunting up strange places, and now and then favorite old haunts,—I am interrupted.

Yours ever

LESLEY.

And as we are speaking of Lesley, we may here refer to a letter written soon after their return and evidently prompted by Hall's experience and personal touch which he had now acquired with the work of his European colleagues. In this Professor Hall proposed to introduce the term "Appalachian System" as equivalent to the term Palaeozoic. This important suggestion was obviously made with full comprehension both of the distinctive physiographic development of Appalachia in contrast to the procedure in the rest of North America and in Europe, as well as in the expression of its life record. Today we can not fail to recognize the appropriateness of this term that would

thus have designated the special peculiarities of Appalachian structure and history. It was too late to make the substitution; it was not, in fact, a term which could be used in place of the biological word *Palaeozoic*, but it finds itself, in somewhat broadened application perhaps, in the more purely geographical name of *Appalachia*.

A Devonian Forest.

“Petrified Forests” are among the sensational things in geology. The Arizona jasper forests of Triassic age, the standing trunks in the Coal Measures of South Joggins in Nova Scotia, the Purbeck forest beds of England, are all obvious marvels. It happened to Hall in 1870 to bring to light an older forest growth than any of these named or before known. This was the discovery of a number of great trunks and spreading roots of giant trees, of still unknown nature, in the Devonian sandstones at Gilboa, a village in the upper Schoharie valley, a place now about to be submerged under the impounded waters of the Schoharie creek, which are to become a contributory to the New York City water supply system. Five or six of these trunks were found erect in these rocks, and most of them are now in the State Museum, absolutely unique illustrations of the Devonian land flora. Recently this ancient forest has been rediscovered and the record enlarged by finding two other growths of them at

other levels in the rocks. Dawson was then writing on Devonian plants and gave a brief account of these trees, but left their real nature to be determined and their interesting story still remains to be told.

Legislative Modes.

Occasionally we catch a glimpse, among the incessant demands for financial support to the Palaeontology, addressed to speakers of the House and chairmen of Finance Committees, of the easy way the business of the State Museum was transacted. Out of a beneficent heart, Mr. Erastus Corning, the ironmaster of Albany, advanced, in 1871, the purchase price of the Jewett Collection of New York Fossils and the Emmons Collection of Minerals, both of great, the latter of unique merit. The money is, it is confidently assumed, to be paid back by legislative enactment and when the item for such repayment fails to appear in the appropriation bill, Mr. Hall writes to the Chairman of the Committee (Jarvis Lord) expressing an aggrieved surprise at its action, in view of the great service these collections were to the Museum, and so the reimbursement is goodnaturedly made. Would that such good nature still survived!

And one of his failures at this time was to induce the legislature to buy the two collections of Trenton and other fossils made by Charles D. Wal-

cott and his associate Mr. Rust. This was in 1873 and the effort was the first contact between Hall and Walcott. The beauty and perfection of these fossils from the Trenton limestone deeply impressed Professor Hall, and his urgent recommendations are expressed to Senator Daniel P. Wood in glowing terms. "The collection," he writes, "far exceeds in number, beauty and perfection all the collections that have been made from the Trenton limestone in New York or in the United States during the past fifty years. No language can convey an adequate idea of the beauty and perfection of the trilobites, etc." But even from his strong friend, Senator Wood, whose public help to science Hall in his later years commemorated with a gold medal (now in possession of his daughter Mrs. George Huntington Williams), he had to accept the fatal but historic reply so familiar to official science: "Not this year."

Sale of his Collection.

Professor Agassiz's death in 1873, when the great teacher had hardly passed his prime, was a profound deprivation to American education. To Hall his friendship and counsel had been invaluable for 25 years and the loss was deeply personal. The quality of Agassiz's friendship and devotion may be seen in one of his last letters (June 1873) in which he refers to the generous gift of money

(\$100,000) made to him by his son and daughter, and his disposition to use it for the acquisition of Hall's now tremendous collection. Except for this, the hope which they both had nourished for years, was gone — for the Boston friends afforded no anchorage. Hall replies to Agassiz's suggestion: "I do not think it right to apply this to the purchase of my collection. It is intended for your own personal use but even in that way it will be available to do much good for the Museum and for science." I think this is the last communication that passed between the two — a fair expression of the same mutual regard which brought them together. The son, Alexander Agassiz, was unable to hold out any hope of realizing his father's purpose with reference to the collection and on April 10, 1874, writes:

"Father has left me a load to carry such as it is impossible for any one to carry without breaking down under it. I am so differently constituted from him that although I dare say the prospects I have would seem to him paradise yet to me they appear so gloomy that I hardly know where to turn and I doubt if I can stagger under the load much longer." And he feels compelled to terminate the matter by "leaving him [Hall] full liberty of action."

Thereupon began the negotiations with the new Museum just organizing in New York City through the indefatigable efforts of Albert S. Bickmore. Mr. Bickmore had been a student with Agassiz at the Penekese School and realized that for the geo-

logical part of the Museum the Hall collection would form a brilliant nucleus. The collection was sold, the Trustees of the Museum paying \$65,000, and it may well be a matter of record that it constituted the first important acquisition by purchase in this now great museum-university, the American Museum of Natural History, and so was in a sense the center about which its enormous scientific collections have grown up. It was quite necessary for the continuation of Mr. Hall's investigations that he should reserve the use of considerable parts of the collections, but this was with full understanding on the part of the trustees. It was an unavoidable, but as it afterward unhappily proved an entangling provision, though it was sought to obviate all embarrassment by having every specimen so retained ticketed with the monogram of the American Museum. It was a simple fact that Hall parted from these scientific possessions with greatest reluctance and misgiving, in spite of his pressing need of money. So hopeless was it for him to get along without the tangible objects of his study that he forthwith proceeded to spend a part of his new money in more fossils, to fill his thousands of empty drawers and shelves; and it may be added that at his death he left behind a collection much larger though probably of less scientific value than the one which went to New York City. For months in the year 1875 all hands at Albany were engaged

in the work of packing and shipping this great collection, aided by Dr. Bickmore and his young assistant, George Frederick Kunz.

With all this money Hall was now able to retrieve some of his dubious ventures in North Carolina and Georgia gold mines and in Salisbury (Conn.) iron. It is proverbial that when a professional man, lawyer, physician or minister collides with a mining proposition some tender foot is lacerated; but it is a most surprising thing that Hall, who had been the first to report officially on the iron ores of the Adirondack region, should have deliberately sunk one-half his money in a carefully laid trap among the magnetites of Essex County. But he was just such a curiously confiding man, forever trusting the plausible stranger, even while distrusting his most devoted friends.

An annoying issue arose from the transfer of the Hall collection to New York, which came near disaster for the State Museum. Mr. Bickmore and his friends seemed to feel that now having possession of the Hall fossils with a large number of the type specimens on which the "Palaeontology of New York" was founded, it would be a very fine thing to get possession of the entire State Museum; that is to transfer the Museum and all its activities, including even Professor Hall himself, to New York City. Mr. Whitfield had already been induced to go there because of his indispensable knowledge

of the collection. The American Museum then had for superintendent of its building — the bare little brick transept which stood so long alone in its nakedness on Manhattan Square — a man who took vast pride in his personal acquaintance with all sorts of politicians in every part of the State, won by the help of a warm hand at county fairs and other local meetings. So when the proposition was set afoot in the legislature this man's activities assumed a very menacing aspect as they were quietly encouraged at the New York City Museum. Then Hall rose in his wrath against his assailants. He found a friend in New York in Theodore Roosevelt of the Museum trustees and another in Albany in James W. Husted of the Assembly, whose smooth poll had won for him the sobriquet of the "Bald Eagle of Westchester." These efforts together put the enemy to flight and the victory was again commemorated by a gold medal which Mr. Hall in his old years presented *in memoriam* to Mr. Husted.

Not all of Hall's legislative tangles are worthy of note. Some of them, however, have left their mark on the record of his work. In 1873, Thomas G. Alvord of Onondaga county, better known in his day as "Old Salt," was a member of the legislature who, through some pernicious influence, had declared his purpose to "rip up" the whole matter of the "Palaeontology of New York" which he proceeded to do just at the time the work was most

deeply involved in many directions and could be easily wounded. The "Old Salt's" line of argumentation was to begin back at the start of the Survey and charge all the expenditures of 40 years to Hall and then demand the results, a rather showy and specious procedure. Alvord delighted to put Hall in a difficult situation and was an irritating thorn in the flesh for a long time, until Hall sent out a cry of "all hands" to his friends, Dr. Newberry, President F. A. P. Barnard, Senator Daniel P. Wood, James W. Husted of the House, and others, and the response was so prompt and effective that Alvord retired from the field.

"I am sure that I express," wrote Dr. John S. Newberry on this occasion, "the feeling of all the scientific men of the country when I say that it would be a great sacrifice of the general interests of Science and of the dignity of the great State of New York if your work, so important to the scientific reputation of the country and our State, should be even interrupted. You can perhaps afford to stop and be content with the splendid monument which your work already done would form, for it would give you undying fame, but we, the geologists of the country and the State of New York can not afford to have you stop for an instant, least of all leave your unpublished facts and material to the chances of an uncertain future and to the hazard of life, death and political changes."

Soon after Hall's first visit to England, Sir Andrew C. Ramsay, who had just become Director-general of the Geological Survey of Great Britain and Ireland, writes as follows:

28 Jermyn St., LONDON,

16th June, 1873.

"I have no special news for you. I am trying to get the Geological Survey Offices and the Museum in general much enlarged. We are dreadfully in want of space for fossils, minerals and rocks, but I very much fear there is not much chance of the Chancellor of the Exchequer granting the necessary funds, even if I persuade the Department under which we serve to make the proper representation.

Among other things I thought I might have a little more leisure after succeeding Sir Roderick in the office of Director-General, but such is not the case. I hoped to get rid of my Professorship, and though I think they are willing to clear me of that duty they seem in no hurry to do so, and I can not afford to part with the emoluments thereunto attached, for when Sir Roderick died, they abolished the Office of Director of the School of Mines, so that my salary is £300 a year less than his was, and therefore I am obliged to stick to the Chair.

Next Wednesday is the last sessional meeting of the Geological Society, to be celebrated by an onslaught by the President (the Duke of Argyll) on my theory of the Glacial Origin of Certain Rock-bound Lake-basins. It does not much trouble my mind, for if it amuses him I think it does me no harm.

I hope to get to Germany before the summer is over to attempt to explain the physical origin of a large part

of the Valley of the Rhine. If my suspicions are well founded I do not know into what villainous heresies the subject may lead me.

Give the united kind regards of my wife and self to Mrs. Hall and the family in general. All my family go next week to Beaumaris in Anglesey to spend most of the summer. We have a house there which is very convenient. I wish that you could be of the party, for then I would take you over the Silurian rocks of North Wales in general.

Believe me

Yours very sincerely

AND. C. RAMSAY "

Henry Alleyne Nicholson is a name well known to palaeontologists. Nicholson came to this country from England apparently to seek out his fortune in geology. He seems to have arrived in 1871, and for a while made his headquarters at the home of the Reverend Doctor Buddington of Brooklyn. He does not hesitate to come at once to Albany and tell Hall, with true British confidence, that he understands it is proposed to appoint a State Geologist in Virginia and "if this be so I shall apply for the appointment." Nicholson soon learns more of the American mode and presently takes a professorship of Natural History and Botany at the new university of Toronto. While there he was busied with some studies of the Graptolites and prepared a well-known but very brief official report on the Devonian of the Province of Ontario which, to use his

own expression, is "rather shabbily got up as our legislators do not much care about spending money on 'clams and salamanders.'" Here, too, he prepared a Text-book of Palaeontology which was very helpful in its day and the first book of its kind on the continent. By 1874 Nicholson had tired of the western world and asked Hall for a letter of recommendation to accompany his application for a collegiate position at home. Soon thereafter he became attached to the College of Physical Science at Newcastle-on-Tyne and joined with a number of active English geologists; Bonney, A. Geikie, Carruthers, Holl, T. R. Jones, Jukes-Browne, Rudler, Topley, Henry Woodward and H. B. Woodward, in the editorship of the "Geological Record."

The correspondence of these years shows other items which are pleasant and instructive to recall.

His friend G. C. Swallow reveals one of Hall's abandoned ambitions. Writing from Columbia, Mo. in 1875 he says:

"I hope you will be able to carry your work through the Carboniferous and Permian Systems, for we have no one who will be able to handle the entire subject. You alone are in a position to work up these systems impartially and correctly."

Frederick Starr of Auburn, N. Y., a lively collector of fossils, 18 years old, writes a letter of excited enthusiasm (1877), adding "I hope that after reading this letter you will not say 'I wish those

everlasting boys were not so troublesome.' ” Starr was busy grinding out the spirals in the fossil brachiopods and kept Hall's interest so keen that for two or three years he tried to make a place for him at Albany, but the means were lacking and the budding palaeontologist was left to evolve into the distinguished archeologist of Chicago University.

Doctor Charles Wachsmuth of Burlington, Iowa, who, with his colleague, Frank Springer, attained topmost eminence for his knowledge of the Crinoidea, writes (1877): “ It was a bad move of our Iowa legislature that the Survey under your direction was ever discontinued.”— a pleasant reflection from a gloomy page but a sentiment which paid no outstanding claims.

A letter of 1879 affords a glimpse of the lively zeal of the banker-palaeontologist, B. E. (Sir Edmund) Walker, then of London, Ontario: “ When you were in Hamilton last summer, Captain Prout had occasion, owing to my father's absence from home, to introduce me to you, you having called to see some specimens in father's cabinet. I am myself constantly at work during my spare hours from business either collecting or working at the classification of my specimens.”

And speaking of Toronto, there was another devotee of the science in the little village of Elora not far away, where the rocks of the Guelph formation brought forth many peculiar fossils. David Boyle,

subsequently knighted for his eminent public service and his contributions to ethnology, begins a correspondence of many years with a letter dated 1876, written on behalf of the public museum of Elora, of which he says: "It is, outside of Toronto, the only public Natural History Museum in the Province and may almost be said to be without one cent of endowment or grant except what I raise by lectures, etc." Here is a characteristic passage: Ferdinand Roemer, his friend of 1845, now professor at Breslau, writes in 1874: "If you will send me that box with Helderberg fossils collected by myself in 1845, it will be highly gratifying to me." Again in 1876: "I left a box with Helderberg fossils in 1845 with you at Albany. * * take the trouble to send them to my address." In 1878 Hall was planning to visit Europe, hence: "I just received your kind letter in which you promise to send the fossils which I left 32 years ago with you."

The Federal Surveys.

During these years, in the geological exploration of the public domain the Federal Government was a divided house. Lieutenant Wheeler was conducting a survey of the country west of the 100th Meridian; Clarence King directed the Survey of the 40th Parallel; Ferdinand V. Hayden, the U. S. Geological (later the Geological and Geographical, 1877) Survey of the Territories (1874).

King's studies of the western mountain ranges aroused his interest in Hall's theory of mountain making, enunciated 20 years before, and we have referred to the correspondence on this subject between these two men.

In 1879 the influence of Clarence King's winning character was bringing about a consolidation of these various official surveys and we find Hall urging upon President Hayes, King's appointment to the directorship, and it is of interest to insert here a letter of this time from Hall to King:

February 15, 1879.

"Anticipating the change that I hope may take place in the organization of the Geological Surveys of the Territories, I beg leave to recommend Mr. Charles D. Walcott for a position as assistant on your staff. Mr. Walcott has been with me for two years past, his duties having been chiefly in the field where he has done very excellent work in the collection of fossils and their preparation for the collections of the State Museum and for use in the palaeontology of the State. His palaeontological studies up to the present time have been chiefly among the trilobites of his own collections where he has done excellent work. He is now engaged upon some operations of wider character and has in hand already for publication an interesting paper upon the Utica slate, its fauna, its geological relations, geographical range, etc.

In all the work in which he has been engaged I have had every reason to be satisfied.

I am

Very truly yours "

As a result of this letter Mr. Walcott soon left Albany to begin his eminent career at Washington, and before long he was encamped for the winter at the bottom of the Grand Canyon of the Colorado as aide to Major John W. Powell.

Volume of "Illustrations," and Second Trip to Europe.

Premonitory grumblings at Albany over delays in the publication were now menacing. The last volume had come out in 1867 and the years were running on, with annual appropriations but with no visible results. Hall had started so many lines of investigation and his work had grown so far beyond his expectation — though it always did that — he found himself embarrassed in justifying his delays. In the eleventh year from the time of his Volume IV the flood of new volumes started, one following quick upon the heels of another, but in trying to tide over this long interval he felt compelled to present some sort of showing. So out of his own pocket-book he issued a volume of plates of his drawings reproduced by the new "Albertype" process devised by Albert Bierstadt, entitled it "Illustrations of Devonian Fossils," bound up 130 copies and distributed them among the legislators and a few scientific friends. It was a novel and valuable production; it was the first time this gelatine-process had been applied to such illustrative purposes, and

among these plates, though most have been reproduced in subsequent volumes of the regular series of the "Palaeontology," there still remain some as standards of reference not yet elsewhere reproduced. Of this supernumerary volume Desor wrote:

NEUCHÂTEL, 13th March, 1878.

MY DEAR FRIEND HALL:

I am very glad and thankful that you have given me such a nice opportunity for sending you an assurance of life and an expression of my gratitude for your splendid volume of *Illustrations of Devonian Fossils*. It is splendid indeed, not merely in its execution but also in its arrangement and by the grand impression which it makes as to the nature of this extraordinary fauna. Parliamentary duties have prevented me from acknowledging sooner the receipt of the fine volume. I intend to present it tomorrow to our Natur. Society.

Surely you could not have given me a better proof of the entire and complete restoration of your health. I may imagine seeing friend Hall again active and full of initiative among his treasures, a very different man indeed of what he was when he came over to Combe-Varin. The tree of the avenue which is dedicated to you, although not young, seemed to warrant by its vigor and healthy look that its godfather should recover the same health and so it was, Heaven be blessed.

As to the technical execution of the plates. I confess that I am only able to admire it without understanding it. Is the printing made on stone or on copper or on steel? The fact is that it is wonderful and that it would admirably apply to Echinoderma and Bryozoarians and likewise

to fossil plants. Your plates are unquestionably superior to the heliotypes in Al. Agassiz's work, although the latter are better than those of Al. Agassiz's great work on Echini.

Could you give me an approximation of the costs of a plate like that of your corals? Are they more or less costly than mere lithographs?

I have been much engaged for the last year in the various methods proposed against the Phylloxera. We have some hope that we may succeed in getting rid of this horrible beast by means of the sulphur-acid (*acide sulphureuse*) when applied in the liquid form.

Scientifically I am prosecuting my inquiries about the relation of the pliocene with the glacial deposit. I hear with great pleasure that your son takes great interest in this question, and that he has obtained excellent results. The United States are a glorious field for this problem. I hope to hear again some day from you and your fine labors.

Believe me ever

Yours

E. DESOR

Hall's apprehension over the situation which made this publication of the "Illustrations" advisable, is reflected in the following letter from Joachim Barrande:

PRAGUE, *June 19, 1878.*

* * * "I can easily understand the agitation in which you have been for many months until the publication of your *Palaeontology* of N. Y. was assured. I beg to assure you that all the geologists and palaeontologists of Europe attach great importance to the continuation

of this work which, in their eyes honors the legislature of the State of New York. That State is in fact the first which has recognized the importance of the exploration of its rocks and it has long sustained the enterprise so useful to science in general. At this moment, when you have almost reached the end of these long and laborious investigations, no one can imagine that an old servitor of the State will have his publications arrested. Happily good sense and sentiments of National honor prevail among your legislators. I felicitate the State of New York which thus conserves the high consideration which that body enjoys among the savants of our continent.

I express to you also my personal felicitations with the hope that you will be able to peacefully conclude your work and enjoy the satisfaction which you have well merited by application so sustained through long years. My views are shared by all my friends."

And of like import is this letter of a few months earlier with its splendid tribute:

1878 Jan. 25

"I thank you for your magnificent volume of 130 photographic plates which I received from you last autumn. Your Devonian fossils are very beautiful and I greatly regret having received the volume too late for mention in my 'Etudes generales' of the Cephalopods."

The study of the Brachiopods has often compelled me to resort to your magnificent volume IV published in 1867. Each time I sincerely admire the beauty of your fossils, the perfect figures by Mr. Whitfield and the clear and methodical text of my *master* Prof. J. Hall."

3

Second trip to Europe — O. Novák — Organization of the International Geological Congress — Buffalo International Committee of 1876 — Hall its president, and organizing president of the first Congress, at Paris, 1878 — His address — Other incidents of his visit — Ramsay, Desor — Barrois of Lille returns with him — Barrois's geological cruise in America — Death of Joseph Henry.

DURING the period of the Centennial Exposition of 1876 which brought a great many European savants to America, there was a conference in Buffalo of the geologists of the American Association for the Advancement of Science, who were desirous of forming an organization which would help to illuminate the puzzling matter of the correlation of geological formations over the world and secure some sort of uniformity in interpretation and map construction. Thereupon was organized a sort of preliminary committee or Committee of an International Geological Congress, an organization which was authorized to arrange for a world-wide canvass of geologists with reference to the proposal and to fix date and place for a meeting. Mr Hall was the President of this Committee and its other American members were Hunt, W. B. Rogers, Dawson, Newberry, Lesley, C. H. Hitchcock and Pumpelly. Huxley, who was at

the Association meeting, was the British member; Torrell of Sweden and Baumhauer of Holland, the other European members. The meetings were set down for August, 1878 at Paris, and the time had now arrived. As this important event, in which Mr. Hall had the deepest concern, drew near, he found himself so deeply involved in his labors at home that he felt he could not go so far and leave his scientific machine, for Whitfield had left him, Walcott was about to go and Beecher, though on the way, had not yet arrived. He felt the need of more help and he had been asking Barrande to send him a young man to assist in the work; request to which he received this reply:

"Directly on receiving your letter I made search for some one able to carry on the functions you have indicated and aid you in your preparatory labors. I have found a young man about 22 years old, who seems to me to possess these qualifications. His name is Novàk (Ottomar) and he has had his scientific training at the Musée Bohême where he has been working for many years as assistant to Prof. Anton Fritsch. Mr. Ottomar Novàk, after reflection, has told me that he would accept your propositions if they will assure him a respectable living. Mr. Novak is a young man, well educated, studious, and of a very sweet and peaceable character."

Novàk did not come, but went off with Suess to study Vesuvius and Etna, and Hall started for Europe, not waiting for the arrival in Albany of Beecher. His absence was not long but the trip

afforded him opportunity to meet friends in England and to enjoy the profuse hospitality of the French. More than that, the occasion at Paris was of the highest scientific moment. A large and thoroughly representative body of geologists came together from all quarters of the world, except Germany. Mr. Hall, as organizing president, opened the way for M. Hèbert, who was president of the sessions. At the opening meeting on August 29, Mr. Hall presented his views on the nomenclature of the Palaeozoic Rocks in a paper that was at once translated into French by Barrois and has, I think, never appeared in English. It was a rather important document in a historical sense for it recognized the Cambrian System of Sedgwick as including all the divisions of the Palaeozoic from the base up to the top of the "Hudson River beds." At the close of his paper Mr. Hall made these remarks:

"An International Geological Congress such as is now assembled here, has been for a long time the aspiration of many individuals and the subject of repeated proposals, but it has heretofore not been possible to propose any satisfactory arrangement. The letter of Professor Capellini, which is found printed among the documents we have had before us, shows that Italy, the cradle of geology, had thought also upon the advantages of such an organization. It was not possible, however, to reach a solution of the question of the Congress by correspondence and it was only upon the occasion of the celebration of the Centenary of the United States in 1876 that the hope of seeing such

a Congress as this organized, took on substantial form. This Centenary, followed by the meeting of the American Association for the Advancement of Science, had this result; that without precedent in the history of our country there was a gathering of scientific men of different countries so large as to make possible close personal relations and an exchange of ideas which permitted us to work out and propose the plan of such a Congress as this.

I have now before me the fruit of these efforts in this great assembly of scientific men where are found representatives of nearly every country of Europe and a considerable number of geologists of merit from North America. Permit me, gentlemen, to express, in closing, the view that our work and our reports will exercise an important influence upon the progress of the science which is so dear to us." (Vifs applaudissements).

In reply to which Mr. de Baumhauer said:

"Mr. President: In the name of the Congress I thank Mr. Hall and I heartily endorse the views which he has so well expressed." (Nouveaux applaudissements).

Among the other American members of this Congress were Thomas C. Chamberlin of Beloit, Director of the Geological Survey of Wisconsin; George H. Cook of New Jersey; Henry Hanks of California; Edward Cope of the U. S. Geological Survey; E. B. Cox and J. P. Lesley.

It is not, thus, to be forgotten that Mr. Hall was the organizing president of the International Geological Congress which, up to the breaking out of

the Great War, had held thirteen important meetings in various parts of the civilized world, its last being in Canada in 1913 — meetings of so eventful a character as to have elicited large cooperation and support from the receiving governments.

The time at Hall's disposal was too short for much visiting with friends. There are some echoes of this trip that appear in subsequent letters, of which those that follow have contemporary interest. While stopping with Dr. Bigsby at Portman Square, his old friend Sir Andrew Ramsay, Director of the Geological Survey, writes in his growing blindness from his home in Wales:

7 Victoria Terrace

Beaumaris, Anglesey, 20 *Sept.*, 1878.

My dear Prof. Hall;

I received your note of 18th this morning and am troubled at not having a chance of seeing you, you fly about so rapidly. If they had telegraphed my address to you to Liverpool, you could easily have come round this way en route to London. We have a house here where my wife and children come in summer, and where this year I have been confined ever since the end of July. Something went wrong with one of my eyes and I was obliged to go to Liverpool for an operation on it, and my whole health got deranged thereby. I am not now fit for work and must neither read nor write, but I am mending slowly.

My wife and I have promised to go on Monday for a week to Port Madoc to visit Mr. and Mrs. Homfrey

(Ammonites Homfreyi¹) and if you could only come there for a day or two under his guidance you would see the Lingula flags and Tremadoc slates to perfection. If practicable for you, Port Madoc is easily accessible from London by way of Chester and Carnarvon, and there is a good hotel (Sportsman) where you could sleep and Homfrey would give you a good dinner. Letters will reach me here on Sunday and Monday morning. After that care of David Homfrey, Esq., Port Madoc.

I shall be very glad of any mission that would take me to America again. It is two years since I have been out of Britain, my last journey being to Gibraltar on Water Supply business for the Colonial Office.

I wish we had you here where from our windows you would see such a view of the Carnarvonshire mountains a few miles off. My wife would send her kindest regards to you were she at home. Yours most sincerely,

A. C. RAMSAY

Desor, whom Hall had hoped to visit at his home in Jura, sends the following:

Nice (Rue Gioffredo 56) 25th November, 1878.

My dear friend Hall;

Do not be angry that I have delayed so long to answer your kind letters of the 10 and 22d September which have been both duly received. The fact is that until to the last moment I entertained some hope to go to Paris and to see some of the friends and colleagues you have met there and hear their impression about the Congress. Unfortunately my esculaps did not allow it, for fear that I might

¹ A father may be distinguished in his son, but when before was a man distinguished by the fossil named after him!

get too tired. It was one of the greatest privations for me to submit, for I would have met many an old friend and acquaintance whom I will probably never see again. I read and followed with great care your discussion at the geological Congress, and have also learned with great satisfaction that you have met there with the due regard which you deserve on account of your hard work and successful investigations. I consider also that as far as an attempt to coordinate the various formations in both continents was aimed at, your cooperation was indispensable. It was indeed indicated that such an attempt should begin with the palaeozoic formations because they are on the whole more homogeneous the world over than the more recent ones. Now it is certain that nobody has investigated a greater amount of palaeozoic faunas as you, and therefore nobody can pretend to have a better comprehension of the leading features of any period of this great era. Bye and bye when we have come to a result concerning the parallelism of the palaeozoic groups, it will perhaps be less easy to try the same for the mesozoic series. It may be however that something of the kind will be proposed at the Congress of Bologna, although it will be rather a hard task to coordinate the Trias of the Alps with its equivalent of the Anglo-french basin.

I hope you will have reached your home in a satisfactory state of health and have resumed your work with renewed energy, although I wish and hope that you will take care not to overwork yourself again. There is a limit to our capacity, and it is time for the sake of science and for your own welfare that you should limit yourself in your task. Remember the italian axiom "*qui ve sano va contano.*"

As to myself, you will see from the heading of this letter that I have succeeded at last in leasing my Neu-

chatel home in order to get out of the way of our Swiss fogs and easterly winds. I have settled here for the winter on this beautiful shore of Nice (Nizza), where I have met again a splendid sunshine. It was indeed so warm today, that we had to walk quite slowly in order not to get into perspiration. I have hired an apartment for the season and old Mary is preparing my meals, which is by far preferable to the hotel-fare. There is also quite an interesting field for geological inquiries. There is yet much to do and it is but a very short time since a geological survey of the department has been decided. I will try to look first at the erratic and diluvial phenomena, raised beaches and the distribution of erratic boulders, of which very little is known thus far. The prehistoric phenomena are more striking and there are as I am told in the neighborhood many caverns which contain palaeolithic and neolithic remains similar to those of the caverns of Mentone, where the prehistoric human skeleton of the Paris collection has been detected by M. Rivière. But the most fascinating features are that of the landscape. I imagine Mrs. Hall would be in the greatest admiration in looking at these gardens covered with roses and various other flowers in full blossom, not to speak of the palms and the oranges and lemons which are just now ripening. * . *

Yours truly

E. DESOR

The Count de Verneuil, now nearly 70, writes to tell his experience in Spain after leaving Hall in Paris and ventures to remind Hall that the \$200 borrowed of him in 1845 has not yet been repaid! The letter is genial and kindly and the writer adds that he has discovered the Potsdam Sandstone in

France with just such fossils as occur in it in Wisconsin.

Still keenly on the lookout for a lieutenant and having failed in the effort to bring the promising Czech Novák² into his labors, Professor Hall met at Paris a young doctor of science, then lecturing on geology at the University of Lille, Charles Barrois, to whose aspirations and from whose devotions his heart warmed. The casual acquaintance led to an invitation to Barrois's home where the gracious reception and the sympathy of like interests led Hall to endeavor to persuade the young Frenchman to join his corps in Albany. In this he was not successful, but he did succeed in persuading Barrois to accompany him to America under the promise of giving him, through personal introductions, the opportunity of traversing the regions of greatest interest to a geologist. So in September (1878) they two sailed for America, Barrois meeting Hall at Liverpool. Arriving at Albany, he is started on his travels with a bundle of helpful letters to geologists and others north, south, east and west. To classic Schoharie and the Helderbergs, to Lake Champlain and into Canada, to Amherst to see the great Hitchcock collection of Triassic foot prints, then south to seek Cook in New Jersey, Lesley in Philadelphia; to Harrisburg, Oil City, localities in Ohio, seeing

² Novák did some very useful work in palaeontology and gave promise of greater things, but died early.

everyone who had something geological to show. From Chicago Barrois writes: "Your name is such a recommendation that not only all houses are open to me but I am welcome everywhere." Through Minnesota, Wisconsin and Iowa where at Burlington, Doctor Wachsmuth writes: "We visited localities with 2 feet of snow on the ground and at Davenport the thermometer stood at 25°F." By Christmas the young doctor is at St. Louis where he declares he has learned there are only two cheap things in America, "turkeys and the Missouri geological reports." Coming by the Southern States he strikes Richmond "the very day," writes Kerr, "the legislature passed a bill abolishing the Geological Survey."³

By Washington and New Haven back to Albany to say good-by to Hall, Doctor Barrois sails for home in February, laden with the spoils of his cruise. Amiable and zealous, Barrios made and left many friends, but to Hall he had become and remained, as later years abundantly proved, almost in *loco filii*.

Joseph Henry.

In 1878 occurred the death of Joseph Henry, discoverer of long distance electrical transmission and

³ W. C. Kerr, who had been serving as State Geologist of Virginia, was one of Louis Agassiz's pupils and had acquired his interest in geology "by making a tour of your State with Colonel Jewett."

the great first secretary of the Smithsonian Institution. Professor Henry had been Hall's friend from the start. To his wise counsel and his sympathy he was often bound. This acquaintance dated back to the Albany days while Henry still retained the impressions of his geological experiences with Amos Eaton. We have quoted an historic letter, asked for by Professor Henry when in the midst of his troubles with S. F. D. Morse, and may well give here Hall's final outpouring of tribute to the long friendship, in a letter to Mrs Henry.

"I have hoped to be able to write you as I would wish to write, to express my sympathy and condolence with yourself and family upon your great affliction in the death of a kind and noble husband and father. I can say nothing to assuage the grief or mitigate the sorrow for the loss you have sustained, but I may have the melancholy satisfaction of expressing to you my great appreciation, my love, esteem and reverence for the man whom I have known for so many years, a man who while living deserved and received the confidence and homage of every man of science of his country and the world. I had known Professor Henry from the time I was a student in Troy more than forty-six years ago. He was the realization of my ideal of a true scientific man; honest, earnest and patient in all things and with all men except with pretenders to science. He won the esteem and confidence of all who approached him. In all the little controversies among his associates in science he had maintained such an attitude as became a man of his exalted position and I do not know the man who bore him ill will. During a long life he had

kept aloof from all those influences which seem to weaken or destroy the independence of so many men of science. This, together with his simple and unostentatious life, his quiet and unpretending manner while standing confessedly at the head of all the scientific men of his country, has presented a grand example to the younger men while it has secured for him their love, esteem and veneration. I believe there has been no man of the generation in which he lived who has so endeared himself and his memory to men of all professions and departments of scientific inquiry. For almost half a century the name of Professor Henry had been recognized as among the foremost in scientific investigation and he has been known wherever civilization has extended; his name is inseparably connected with one of the greatest discoveries of modern science and its application to the requirements of civilized life. The "eternal fame" predicted in the letter of introduction which I took to him in 1832, has been as fully realized as is possible in human life and human affairs, and his name will be long remembered among the benefactors of his race. Yet all of worldly good or worldly fame will weigh as nothing against the ties of love and affection which have been broken. But if ever friends and relatives could find amelioration of their sorrow in the recollection of a great and good life they have it in the life and example of Joseph Henry.

With most kind and sincere regards for yourself and your daughters, I remain

Very truly your friend and obedient servant"

JAMES HALL

While Hall was away Beecher was seeing through the press the last pages and plates of the

Palaeontology, Volume V. This volume had been planned on a large scale and as it was to comprehend an accounting of the rich molluscan fauna of the New York Devonian it had to be compendious, but it had quite outstripped the plans of its projector and had gradually taken on the form of four volumes instead of one, these four volumes constituting parts 1 and 2, each in two volumes. It suited the condition of the work to issue the second part first and thus in 1879 appeared *The Gasteropoda, Pteropoda and Cephalopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups*, with one volume of 492 pages of descriptive text and a second with 113 lithographic plates. The work had largely been done by Whitfield, but there are evidences throughout the later parts of it, of Mr. Beecher's fine analytical touches. Mr. Hall did not regard the gigantic work as satisfactorily covering the whole field, and so when Volume VII came out a supplement was added which helped bring his account of these Devonian Mollusca up to the measure of his material. As a further step in "making known" the fossils of the New York Formations, Volume V was a monumental contribution.

CHAPTER XI

THE PERIOD OF THE LATER PALAEONTOLOGIES AND THE CLOSING YEARS, 1879-1898

The procession of the Palaeontologies — Beecher's methods of work — Troubles with the Regents — Removal of the collections — Hall's personality at seventy-five — Geological Congress at Bologna — Italian experiences — Death of Barrande — Theory of evolution — John Collett — Democratic sympathy for Hall's work — Gen. F. E. Spinner's interest — Incautious science — Honors and associates — Gaudry — Lesley — Walker Prize — Geological Map of New York — Geological Society of America — Completion of the "Palaeontology" according to its original plan — Additional volumes begun — Charles Schuchert — Studies of the Brachiopods — Increasing trouble with the Regents — Hall recommissioned by Governor Flower — Independence from Regents — The French calumny — Its results — The later geology — D. Dana Luther — The Adirondack Survey — Edward Orton — Geological Congress at Washington — Tribute to Hall — Sixtieth official anniversary — Goes to Russia — Seventh Geological Congress — Salutations on his return — The Peaceful End — James Hall's influence on his science — His Honors.

ELEVEN years had passed between the publication of the last two volumes of the Palaeontology; but they had been years of active and incessant work and so the years immediately to fol-

low were full of the tangible results of this work. Now the great tomes came so fast they almost fell upon each others heels. Volume V, *The Devonian Lamellibranchiata*, appeared in successive parts in 1884 and 1885; Volume VI, *The Corals and Bryozoa of the Devonian*, in 1887; Volume VII, on the *Trilobites and other Crustacea of the Devonian*, in 1888; Volume VIII, on the *Genera of the Palaeozoic Brachiopoda* followed in two parts, the first in 1892 and the second in 1894. Here, then, in the years from 1879 to 1894 appeared in print 2412 quarto pages of text and 406 lithograph plates, a scientific productiveness which has few comparisons.

In the first of these books, that on the bivalve mollusks, Mr. Beecher had the best opportunity during his career in Albany, to show the quality of his workmanship. In any such book, built up by slow stages as the material and drawings could be prepared, there was inevitably an element of the haphazard; things were done and illustrations were made far in advance of the summation of the work, and thus imperfections and incongruities easily entered. The openings thus left in this work were Beecher's opportunity and where he found a free hand his clever perceptions and keen analytical ability left a new sort of an impress on the work. This was especially seen in one vast group of aviculoid

bivalves from the Upper Devonian, the Pterineas and Ptychopterias which abound in such profusion and variety that it seemed almost hopeless to make recognizable divisions among them. Spread out all together on table tops, that is on one level, they made a bewildering array which took no account of the meaning of the variant forms in their succession in the rocks. Muscle scars, hinge-teeth, ligament grooves and such interior details were the conventional data for classification, but Beecher writes to Hall: "A genus based wholly upon the characters of the interior of the valves is very unsatisfactory. The preservation of these is most diverse; characters which appear in specimens from one stratum are obscured and replaced by others in a succeeding layer. External form must always carry the expression and be dependent on the structure of the animal, and from a careful study and classification of *forms* we may arrive at what is equivalent to a separation based upon a study of structure."—important doctrine and practise to a palaeontologist for whom so often external form is the paramount datum. The recognition and application of this principal gave added virtue to this great compendium of the Devonian bivalves, but the philosophy of the procedure escaped the appreciation of Hall's ever watchful lakeside critics who accused him

again as of yore, of over indulgence in "species-making."¹

Such fine touches imparted by Beecher to the "Palaeontology" were not many; they could hardly be numerous in such descriptive work. They can be seen again here and there in the ontogenetic sketches given by him to the study of the cephalopods, (Vol. VII, Supplement), a result in part of his sympathetic contact with Alpheus Hyatt; but Beecher's keen insight and his skillful manipulating hand were better adjusted to work of another sort. He soon tired of the "Palaeontology" and its multitude of details and busied himself with microscopic photography of brachiopod shell structure and bryozoan fronds. The fine strain of his interests was well shown in such a case as this: While the very extensive material brought in from the Silurian of Waldron, Ind., was being washed preparatory to assignment to its proper place in the collections,² he carefully saved the washings of the slabs in order to get the young forms of the animals of the fauna. Soon after my coming to Albany,

¹ The old outcry against "species-making" came from blind guides with poverty-stricken minds. In palaeontology the whole understanding of successions in fauna and flora and their interpretation for palaeogeography depend in very large degree on definite, refined conceptions accompanied by distinctive designations of the life units involved.

² Hall would not permit any specimen to be entered among the collections until it had been thoroughly washed, a process which, carelessly done, could do as much harm as good.

Beecher showed me a large number of cigar boxes filled with these washings and suggested that we join hands in working out the ontogeny or development history of the brachiopods of the fauna — a field of study that till then was scarcely entered. We conspired together to do this, neither realizing the labor ahead in the selection of the material and the still greater labor of convincing Hall that the completed work should be printed as one of his series of reports but independent of his name. So we went at it, working in our rooms by lamp-light night after night for a year, picking out these minute things from the debris, separating them from all the wash and wear of a sea bottom where life had rioted; and then came the allotment, out of an accumulation of many, many thousands of these baby brachiopods, of each to its own place among the species and in the development series, the study of the progressive changes, the drawing of the specimens and the summation of all the results which the curious reader may see on consulting Memoir No. 1 of the State Museum; a statement which shows the impressive success of our publication scheme. Though Beecher had left Albany some time before our work was printed, the doing of it had undeniably important results for both of us; its lessons were of an elemental nature and guided him in his later work on brachiopod development and me in my own studies of brachio-

pod structure which were then well under way (Palaeontology, Vol. VIII, parts 1 and 2).

In 1882 there came to Albany, John C. Smock, bringing with him, under commission from George H. Cook, the State Geologist of New Jersey, the head of a mighty fossil crustacean (*Stylonurus*), the greatest thing of its kind, which had been found by a Dutch farmer while building a stone fence in the town of Andes in the Catskill Mountains. As the farmer's son was a student of Rutgers College, New Jersey reached out and seized this unique New York fossil, an act never to be forgiven, but palliated in a small way by permission to James Hall to describe it. Thus it came in custody of Professor Cook's assistant Mr. Smock. Three years later Mr. Smock came to the State Museum to remain in the capacity of Hall's assistant director.³ Hall had needed this help and had sought it with the aid of Dr. David Murray, a distinguished educator and Rutgers graduate who was then Secretary of the Board of Regents. Just at this time the chances of succession to the chancellorship of the Board of Regents in which seniority in term of office prevailed, brought to the top

³Dr. John C. Smock, an excellent geologist, retired from the service after a few years, to become State Geologist of New Jersey, and later one of the Commissioners of the Natural History Survey of that State. A man of versatile interests and superior executive talent, he has remained through these years of service to a sister State and until today, a resident of New York.

a man who had conceived a hostility to Professor Hall and evinced a purpose to rigidly supervise and curtail his liberties. Thus arose a troublesome and powerful assault carried on in lamentable and tortuous ways, distracting and distressful to a man nearing his eightieth year with his heart set on the completion of his work. And it was a pitiful thing to see this ancient, venerable, powerfully productive savant who had challenged world-wide admiration for his pertinacious prowess and accomplishments and had brought great distinction on his science and on the State which had fostered it, subjected to annoying restraint which to him could be naught else than persecution. But the sudden death of the chancellor ended it and the Regents revolted so spontaneously against the assault as to bring from Hall the pious ejaculation that he had always "found that the Lord was on his side." The salvation of Hall's latter days grew out of this attack, for at the instance of Andrew S. Draper, a Regent by virtue of his office as Superintendent of Public Instruction, a legislative bill was drawn which was designed to, and eventually did put Hall and his work on a footing independent of the Regents' control.

In 1886, Professor O. C. Marsh asked Mr. Beecher to come to Yale and thither he went, for a while still maintaining informal relations with the State Museum but these were terminated in 1889

by action of the Regents. Albany had been to him a place where he had caught an inspiration for his work and a knowledge of its procedures that were to be his best asset and the basis of the researches which are held today in high esteem.

In the autumn of 1885, I came to Albany partly to attend, so far as I might be permitted, a meeting of the National Academy of Sciences which was held in the basement lecture room of the old Geological Hall, but more particularly to show to Professor Hall and Mr. Beecher a quantity of new things in trilobite and crustacean lines which I had been extracting from the Devonian rocks in western New York. The first part of my experience was tremendously illuminating to a young man. Marsh was then president of the Academy, and it was part of my privilege to be admitted to the banquet hall in the evening after the tables were cleared of all but the great bowl of that classic, fascinating but insidious fluid, the "Regents punch," in response to whose inspirations the scientific oratory seemed to take on a mellow brilliance. I shall never forget my first glowing impressions of the Academicians there present and of whom there still remain Raphael Pumpelly, A. Graham Bell and Edward S. Morse. As for the rest of my errand, the trilobites made so effective an appeal that I was to join the force at once and trust to good luck to edge my way into the service. On the first of January, 1886,

nine o'clock in the morning found me in front of the great stove in Mr. Hall's "office" on the Beaverville, trying to dry my soaked clothes after a rough tramp of two miles through a foot of freshly fallen snow. No one else was there; but presently the ruddy Santa Claus of Hall's figure coming in from breakfast, appeared through the door and with a gray look of surprise in his spectacles as he saw me by the stove, he said: "Oh, yes. How do you do? How do you do? Could you lend me two dollars?" Then began my association of twelve years with this extraordinary man whom I had known slightly for ten years past but whose equations I had yet to learn, and thus arose the necessity which now compels me to project myself into this narrative.

Under a legislative provision of 1884, the State Hall on Eagle street, a beautiful marble building which had been erected fifty years before for department offices, was to be made over to the State Museum subject to evacuation by its occupants; it being assumed that the department officials would transfer themselves to the new State Capitol, then nearing completion. The plan never worked out very well, for the departments with large staffs would not move, but as the smaller departments went out the Museum officials went in, and here and there over the building, some on one floor and some on others, rooms were fitted up for their reception.

The underlying purpose of the plan was to get Hall and the State Collections then in his personal possession out from the quiet nest on the Beaverkill where so much palaeontology had been incubated and hatched, down on the street where the allseeing eye could penetrate their mysteries. And so the change required much fitting and refitting of cases, the transfer of tons of specimens, and ended for the time being in the location of the geological work and its materials on the top floor of the State Hall, with Professor Hall installed in an office room at the northwest corner and myself in another at the southeast corner of the building, mine being the room which had previously been occupied by Doctor E. B. O'Callaghan while preparing the Colonial and Documentary Histories of New York. That room I occupied twenty-five years; but we never acquired any wider occupancy of the building which is now still keeping the classic beauty of its original architecture, the official residence of the State Judiciary. State functions were assuredly mixed in that historic place. Palaeontology hobnobbed with the Department of Banks and Botany with the State Engineers, while Entomology projected its timid head out amongst an army of the Comptroller's bookkeepers. It was in this building, then, that Professor Hall had his official residence from the time of my arrival to the end of his life. My own experience on the "hill" or the Hall estate was very

brief, but long enough to give the assurance that I was the last of that long array of Hall's official aides who had served there: Meek, Hayden, White, Gabb, Whitfield, Walcott, Beecher and others; and it lay in the lap of destiny that I was to be the survivor of my chief.

The most impressive feature of the work, to which I brought a boundless enthusiasm, was Professor Hall himself. Never for a moment did he lose his picturesqueness. His round, full-blooded figure, his heavy snowy beard running well up over his ruddy cheeks, an always erect carriage and a square level look out from under thick brows and over his Moorish nose; dressed in an old coat and in trousers which buttoned down the sides after the fashion of 1830; he was bound to attract attention and curiosity. Every morning after the new regime started, his man Tom drove him from his home in a broken-down, one-seated cart which had once owned a top but lost it long since, drawn by a broken-down nag which had also seen better days and had like as not been taken in exchange for apples or old specimen boxes, his capacious snow-crowned figure capped with a chimney-pot hat towering above his diminutive driver — the jogging figure through the Albany streets was sure to compel notice. Of his irascibility he had at this time lost little, but in address and personal intercourse he was deferential, impressive and punctili-

ously courteous. When the occasion demanded he was fearlessly profane, after the manner of the *vieux temps* when profanity was an art. He drank no little tea, took a little cognac only with his meals, though possessed of a collection of liquors of wide repute, but he had no toleration for tobacco or such lesser vices. In the legislative halls where he was frequently to be found, not only on his scientific business but often for others (his repute as a successful pleader before committees brought him too many cries for help from others to whom he was certain to turn again when his own fates were in the shadow), he was treated with universal respect, for the singleness of his own purposes was never open to question. He laid on the paraphernalia of impressiveness. About this time he had hurt his little finger getting off a Boston street car, and he was daily subject to the winces of sciatica, so when on business bent he was wont to appear in the Halls of State with one arm in a black cloth sling, a walking stick in his free hand helping a limping leg, followed by his secretary, Jacob Van Deloo, lugging a great portfolio of his unfinished work for whose help he was interceding; and in the presence of a committee, this maimed and crippled old man would tell of his plans still unrealized, of his hopes that he might be spared to finish his work; he would talk of Lamellibranchiata and Brachiopoda and Crustacea in the most technical language he could sum-

mon and would leave his auditors benumbed with admiration.

The distinguished Commissioner of Education, Andrew S. Draper, Hall's friend of many years who had served the legislature as chairman of the Finance Committee, used to tell of his coming before that committee on his ancient quest while the members in best of heart thought to have their pleasantries with him. So they began to ply him with: "Well, Professor Hall, what have you done with that money we gave you in 1873?" And "didn't you give a promise to finish your *pailontology* in 1848?" with more of the sort — whereupon the aged Professor whose neck had been bulging and his face getting redder under the bantering, swept his documents together, brought his lame hand out of his sling and down on the table with a bang, shouted in the teeth of his inquisitors, "D——n you, gentlemen, is science to stand and wait upon the pleasure of a legislative committee!", picked up his portfolio, waved his stick menacingly in their faces and marched out. "And," added Dr. Draper, "of course we gave him what he wanted." Indeed in one year they gave him \$83,000 for his Palaeontology.

To himself, a wrong fancied or real, and there were plenty of both, was a crime beyond forgiveness. An injustice to another might be passed over, but never one to himself. And it was this egocen-

tric habit of mind that made Hall so parsimonious in his acknowledgment of scientific assistance even up to those days when he had of necessity ceased to do much else than plan the work whose execution fell wholly on the shoulders of the younger men.

Bologna Congress.

In 1881 Hall went to Bologna to attend the second session of the International Geological Congress of which that year Senator Capellini was president. He was not long away and found time only for short visits to his friends Hèbert in Paris and Desor at his home in the Jura, but especially to enjoy the unstinted hospitality of Barrois at Lille. Barrois was just then very actively engaged in the study of the old rocks of Brittany and the Asturias and the subjects were of mutual concern. Barrois's devotion to Hall was sincere and beautiful and I know how deep was the affection with which Hall responded. This distant friend came forward at every opportunity with offers of help to correct his proofs, to compile his bibliographies, to supply him with materials, laying his successive works before the Société Géologique du Nord and reviewing them all for the French journals.

A part of the outcome of the Bologna Congress was expressed in this letter from Senator Capellini: "I am happy to inform you that H. M. The King

of Italy, the 27 last March signed an order by which you are named:

Commendatore dell'Ordine di San Maurizio e Lazzaro."

And there were other interesting echoes of this meeting. Joseph Meneghini of Pisa, whose work on the Cambrian faunas of Sardinia have established his repute, writes to "My revered Master," to say in his well intentioned English, that "Italy is proud to such a guest. I have had inscribed your name among the more glorify visitors and I glory myself of the happiness I have had to speak familiarly and walk arm-in-arm with the venerable theor of all the paleontologists of our days. * * * I wish you may get happily a great deal years beneficially to the science, accomplimently the desires of your friends and admirers."

It may be of interest to mention here as one of the enterprises which grew out of the Bologna Congress, the ambitious project of the Marquis Antonio de Gregorio, of Palermo, for an international Geological society which was to publish bulletins and memoirs, notes for the Comptes rendus of "the 100 of sciences of Paris," to be published in English, French, Italian and German in London, Paris, Boston, Rome, New York, St. Petersburg, Vienna and Calcutta, the headquarters of the enterprise to be at Zurich. With all its apparent virtues the

scheme died a-borning but the thought comes to us today that perhaps no better project could be devised now to bind up the wounds of geological science.⁴

Among the prominent geologists Hall met at Bologna was Blanford who was just bringing to a close his long and important work in India where he had been engaged for nearly thirty years. William T. Blanford's active life as naturalist and geologist was spent in the Orient and in the intervals of his association with the Indian Geological Survey he was engaged with the geology and zoology of Abyssinia and Persia. He had returned to Calcutta from Bologna and tells Hall (Nov. 1881):

"I am writing from the foot of the Bolan Pass and I expect to go up the Pass to Quetta [on the border of Afghanistan] in a day or two. I hear the country is remarkably quiet now, the fact of one man having been fired at being quoted as something unusual. A year ago things were very different. I have a line nearly if not quite 500 miles long to march over along the base of the hills after returning from Quetta."

Not long after his retirement from the Indian service Blanford became president of the Geological Society of London.

⁴The Marquis de Gregorio was then a young man of 27, already giving evidence of his versatile productiveness in many sciences, to which he had added the composition of several operas.

Death of Barrande.

In 1883 died Barrande, a French royalist in "exile" in Bohemia and whose labors in revealing the wealth of fossil life in the palaeozoic limestone basin of Bohemia constitute one of the extraordinary performances in the history of geological science. The panorama of fossil life of that country, which he set forth in a vast procession of great quartos, surpassed that of New York in the richness of the lower faunas, the Cambrian, Ordovician and Silurian, though where the one was poor the other was rich and in New York it is the Devonian that dominates. Barrande and Hall had been close friends for thirty years; again and again the former's work had been set before the New York legislative committees as an ideal for this State and the last letter Barrande ever wrote on Hall's behalf was addressed (June 17, 1882) to Addison P. Jones, then chairman of the legislative committee on public printing;— an appeal on Hall's behalf that there should be no further delay in publishing his works.

"The Legislature of the State of New York," he says in the opening paragraph of this letter "has given a proof of its noble impulses and a great example of its liberality to science, in ordering many years ago, the publication of the "Palaeontology of New York"; and in closing it he adds: "I may call attention to the fact that the 'Système

Silurien du Centre de la Bohême', an analogous work which I publish under the *royal* and generous patronage of the Count de Chambord, has never suffered any interruption."

Barrande, unlike Hall, was not permitted to see the conclusion of the great work that he had planned. He was indeed crushed under the embarrass des richesses which the Bohemian rocks had yielded and his later works could be little else than the pictured panorama of this ancient life; but pious hands took up the work where he dropped it and carried it toward its founder's hoped-for goal.

Evolution.

No one was ever able to inveigle Hall into a discussion of the evolution of life, though these years were rife with warm debates over the propositions of Darwinism. Unlike his contemporary, Agassiz, who took a conservative but positive attitude on the subject, Hall would take none at all. A life of persistent research should, it would seem, as the years increase and the facts pile up, grasp the broader bearings of the things it had been doing and the facts it had been harvesting. But Hall was no longer disposed to philosophy; it was ever conditions not theories that confronted him and he went on heaping up new facts to the end. Among the friends he had made in his geological work in New York was James R. Eaton, a son of the first

president of Madison [Colgate] University. In these years Mr. Eaton was professor of the physical sciences at William Jewell College, Liberty, Mo., and he was unremitting in his bombardment of questions relating to evolution which Hall does not choose to take the time to answer, and Eaton expresses the hope that "Some time before you go up to the New Jerusalem you will do so." His letters run on for many years; and in his last letter (1894) he says: "And tonight thinking over the Now and Then when you were my inspiration as a boy, the longing came over me to get one more hail from you this side of the river. Wont we have a glorious time over there solving the problems of organic evolution!" Professor Eaton died in 1897, one year before Hall.

Miscellanies.

Among the many beautiful contributions to his science that Hall had made in the State Museum reports which he freely used to carry his lesser papers, was one on the rich Silurian fauna of Waldron, Indiana. There had now come into charge of the State Geological organization of Indiana, John Collett, M. D., a lovable man, well tried in statecraft and with a high purpose to make his work of real worth to the people of his State. Dr. Collett had been a State senator, had held other civic positions and as State geologist he persuaded

Hall to permit the reprinting of his Waldron paper, and another on the Mississippian fauna of Spergen Hill, arranging to have these brought up to the fuller knowledge which new data would give. Hall consented, Mr. Beecher was engaged to prepare the valuable addenda and Dr. Collett incorporated them all in his annual reports; and down upon him swooped the Indianapolis *Sentinel* with virulent allegations as to thus wasting the public funds. Collett's friends rallied to his justification but when the great botanist Leo Lesquereux protested, the offending sheet printed the protest under the caption: A Professional Proof of Pedantry and a Laughable Learned Defense of Debility. This sort of treatment seemed to be a rallying cry to all the scientific men of the State who with one accord came to Collett's aid with such effective rebukes to worldliness that his future procedure was untrammelled.

It is a rather interesting fact that Hall's legislative appeals for aid almost invariably found better support from the Democrats than from the Republicans. When the Democracy was in control, so was Hall, but under Republican supremacy Palaeontology had a hard road to travel. This attitude is, I think, explicable thus (I speak as one trained in Republican tenets): The wise Democrats were ever willing to concede that there might well be meritorious and creditable State activities which

were outside of their personal understanding, but with the Republicans every such activity must be subjected to their touchstone; if beyond their grasp, so much the worse for it. Hall, in his anxiety of 1882, went straight to John Kelly, Grand Sachem of the Tammany Wigwam and the despoiler of the Tweed Ring, and to Edward Murphy, the pilot of the State Democracy and found relief in most substantial figures, enough, it was thought and promised, to carry the Palaeontology through to its end. But as there could be no end to a progressive science, a few years proved that the appropriations did not keep pace with the promise. All the more grateful were these libations to science on the part of the Democracy as Mr. Hall had just been pretty severely handled by the Republican Governor Cornell.

But science and statesmanship do sometimes mix and these years bore witness to the intense interest which General F. E. Spinner (to whom we have referred and who served so long as Treasurer of the United States under the appointment of President Lincoln) still carried into his declining years. General Spinner's home was at German Flatts or Mohawk and he was now spending parts of his summers there and his winters in Florida. He writes in October 1883: "I am at work on the Miocene shells of the Coast of Florida. I spent last summer on the Coast of New England and succeeded in making large and fine collections of fresh

water and land shells from the interior of Vermont and New Hampshire. I had the good luck to meet Prof. Baird and his corps of assistants at Woods Holl on Martha's Vineyard. He promised to send the Steamer *Fish Hawk* to Florida during the coming winter, so I am anticipating a nice time." A year later he writes: "I am again at my old Mohawk home rummaging among fossils and shells, some of which were collected by me half a century ago. There are few days in my long life in which I have had more real enjoyment than those I spent with you and that best of men Lardner Vanuxem, in the field knocking fossils out of the rocks." General Spinner was then 81 years of age. He died in 1890.

And just in these years occurred an incident of a serio-comic scientific sort, forgotten now no doubt but still with a lesson upon reserve in statement of scientific conclusions. The American Association for the Advancement of Science met in Philadelphia in 1884 where Professor Henry S. Williams of Cornell University gave an account of his work in running cross-sections of the Upper Devonian strata of southwestern New York from which he deduced a "mongrel fauna" between the Chemung and the overlying red beds of the Catskill formation. In the discussion which followed Mr. Hall applauded the paper, though questioning the wisdom of the expression "mongrel fauna." Then E. W.

Claypole, of the Pennsylvania geologists, took up the thread of the discussion declaring that he too had found a fauna between the Catskill and Chemung which carried the two *Spirifers*, *S. disjunctus* and *S. mesastrialis*, indices of very distinct geological horizons. This statement brought the septuagenarian to his feet with positive declaration that it was not only contrary to his long experience but to the facts. The warmth of the contention excited the attention of the reporter for the *Philadelphia Press* which came out the next morning with the story that Hall had said: "If any one will show me these two *Spirifers* side by side in the same rock, I will sacrifice my life's work. I will give up my reputation, eat my hat and make the person who shows me the rock a present of my coat and boots!" The story was good and was sent broadcast to the newspapers with amplifications, the *New York Tribune* adding that Professor Williams took the next train for Ithaca, sent on a piece of rock containing the offending *Spirifers* with the message: "You have it now. Please eat your hat and send me your coat and boots by express."

Hall waited patiently a week or so and then wrote out the story for the *Albany Argus*. He had directed his strictures to the statement of Mr. Claypole which he declared was as wrong now as then. Mr. Williams had been summoned to Ithaca by illness at home and had sent on no specimens with

the two fossils together; and he would still eat his hat, etc., if any one, no matter who, could prove his statement wrong. There the story ended except for the unenviable notoriety a man is bound to get when he sends out the truth to catch a lie. But the fact remains today that Hall's claim was absolutely correct.

Honors and associates.

In 1884 Hall was elected foreign correspondent of the Académie des Sciences. Albert Gaudry in announcing this event writes: "I am very happy that so eminent a palaeontologist has become correspondent of the Institut de France and I make to you all my compliments." We may believe that this distinguished honor which made Hall the only foreign English-speaking member of the French Academy at that time, was helped forward by his friends Hèbert, Daubrée and Gaudry.

The friends who made a part of James Hall's life are necessary to the picture we are endeavoring to draw and so we may turn once more to that interesting figure in American geology, J. Peter Lesley,⁵ for his letters during this period throw lights upon his doings and his ways of doing that brighten

⁵ These are of course but incidental touches of this extraordinary man's contacts with Hall. Whoever seeks more of the story of his scientific career will read Professor William M. Davis's charming biographical memoir to which we have already referred.

the published biographies of the man. Lesley was in Europe at every interval he could find from his great work in Pennsylvania and it was his way to bundle up some troublesome manuscript and work it over en route.

In 1881 he tells of his visits to Barrois at Lille, to Hèbert at Paris and Desor at Neuchatel, off to Vesuvius with his daughter and thence back down the Rhine. "All this time I was writing my report on Perry County and painting the map. Nothing will prevent our survey going on for two years and a half, but we are out of funds and my whole corps is furloughed. Margaret went back alone to Vesuvius where she lived three months and then went to Paris where she is still painting in Carolus Duran's Studio." Lesquereux's *Flora of the Coal* was just coming out and he has been reading I. C. White's report on Erie and Crawford counties: "His Ramsayite ideas on the efficiency of glaciers to erode I have cancelled." In 1882 Lesley was again in Europe and once more went to Combe Varin to see Edouard Desor who "is very blind and rheumatic but manages to keep his geology going. His affectionate nature comes out strong." It was a farewell visit, as shortly after Desor died at Nice.

The reports issued by the new Pennsylvania Survey were as sands of the sea for number and Lesley

was put under pressure from the Governor⁶ to prepare a summary and digest of all this work. He undertook it reluctantly. He found it (1887) "extremely difficult, tedious and weary work," and went off to Europe with a pair of sore eyes as a result. He reports to Hall on his return: "I got in three solid weeks of uninterrupted work on my book. Saw nobody but Hèbert and de Margerie, one of the best of the young French geologists. * * * You can't imagine how irksome I find this writing *to the people* for it is a hopeless task to try to make them comprehend even the general nature of the questions which geologists struggle so unsuccessfully to elucidate to themselves. I am often in the spirit by your side, looking over your shoulder, putting silent questions to which I get no answers and wishing you knew how precious I think your long and constant friendship."

The most daring thing that Lesley ever attempted in his survey reports was his own personal preparation of a three volume "Dictionary of Fossils." He catalogued all the fossils known to occur in the Pennsylvania rocks, with many that might occur but had not yet been found. With a pair of scissors he slashed into the pages of a whole library on palaeontology, cutting out original descriptions and illustrations, and he brought Mr. Simpson from

⁶ See Davis's biography.

Albany to make new ones. Lesley was enamored of the work, pastures which seemed to him greener than his own. "I am buried," he says, "in a beautiful hades of fossil forms and wander among them like a poet in a flower garden" (Davis, p. 230). And he was proud of the outcome for the edition of books was soon exhausted. "Jolly nice work" he thought it. In his preface his enthusiasm shows itself: "If Homer's Iliad is immortalized, James Hall's Palaeontology of New York, a more sublime epic, will have a more genuine if not a longer immortality."

An incident here touches on his primitive interest in fossils. In 1892 we had prepared the description of a new genus of brachiopods which Professor Hall desired to name, in honor of a lifelong friend, *Newberria*; and having printed this in pamphlet form Hall sent on a copy to Lesley. The nut-shaped shell reminded him, he writes, of "sitting on a sunny Hamilton hillside south of Schuylkill Haven in Schuylkill Co. a few miles east of Pinegrove and collecting a large number of brachiopod shells in great colonies. The fields were full of them. I have not thought of that adventure for thirty years but your note brought back the whole scene vividly to my imagination. It was in fact the first time I have collected any fossils and I was profoundly ignorant of the whole subject."

The "Dictionary" had intervened in his strug-

gles over the "Summary." In 1888 he broke away to attend the London meeting of the International Geological Congress which he declares was "a mere discussion club," and, again back at his Final Report, he says: "I would rather go to Libby Prison and much rather to the La Trappe monastery near Antwerp where one has to get a special permit to say to a brother — Top of the morning to you Taffy. * * * You don't know how it cheers me to get a line from you and any expression of your appreciation of anything I do is a perfect delight to me. I have worked all my life so apart from the world that it has been a depressive silence making me always doubtful whether I was doing anything that anybody cared a red cent about."

Soon his letters grow few, for Lesley was growing weary. He writes in 1892: "I have been supremely blessed by having the hearty affection of my assistants, and the reason of it is that I have loved them all;" and though he was to live ten years longer, his last written word to Hall seems to have been in 1893 congratulating him on his victory over his official enemies; "but," he says, "you can hardly be expected to grow greater for you are as great as is possible for any man."

Hall was one of the incorporating members of the National Academy of Sciences in 1863, but he was at no time a regular participant in its affairs and he seldom attended its meetings. There are

letters to Joseph Henry in the seventies saying that he could not afford the expense of going to Washington, but the fact seemed to be that the Academy afforded him no outlet for his publications and as for the rest he was not concerned in the material bearings of science. Twice the Academy met in Albany, in 1885 and 1893, both meetings under the presidency of Othniel C. Marsh.

In 1884 the Boston Society of Natural History made to Hall the award of its Walker Prize of \$1,000 for the excellence of his work. Straightway he took his cheque to the Mechanics and Farmers Bank and deposited it "in trust for Science" and he was wont to tell his assistants that this money was for the one who best served his interests in science — a rather hopeless prospect as he was almost constitutionally at loggerheads with his assistants. After the money had drawn interest for ten years the bank wanted to know who this person "Science" was and suggested that Hall could not be the trustee of his own trust. So the prize and its promises were allowed to drop back into his personal account.

Geological Map of New York

During these years of the early eighties Mr. Hall felt that he must give the people of the State a reliable geological map of the public domain on a large scale. There had been no such map issued

since that of 1843 to accompany the final reports of the four geologists and Emmons's map of 1844 specially colored to display his Taconic System. Both of these were of a smaller scale than Hall now proposed. His scientific colleagues for years had been assuring him that with his intimate knowledge of the geology of the State the preparation of such a map would be but a simple task of drafting; and so he entered upon it, little realizing that no one man's knowledge, however refined, can suffice for such an undertaking. The making of this map was a serious thing to begin amidst his other labors and it called for detailed resurveys of regions all over the State. The writer participated in this work before coming to Albany;* Mr. Beecher, Edward Hall, W J McGee, Nelson H. Darton, Charles S. Prosser, F. J. H. Merrill and others were in the field during the years which elapsed before this map could be issued. McGee was the master spirit in control of the work, representing not merely the cooperation of Major Powell and the United States Geological Survey but his own personal devotion to the venerable New York geologist for whom an early life in the fields of Iowa had inspired respect. Only with great and tedious labors did the work come through — an entirely new map of the State on large scale with an original geographic base —

*Geological Survey of Ontario County: Ann. Rept. State Geol. 1884.

still the best map the State has. But such a map can never satisfactorily express geological facts either of structure or succession; only the latter can be approximately represented in broad lines suggesting little of historical evolution and the broad sweep of the strands out of which the lands have emerged. While it is a panorama of high educative value to an elementary student, its other worth is chiefly to the past-master of the science whose comprehensive eye sweeps the lineaments of the whole terraqueous globe.

Geological Society of America

The Geological Society of America, now probably among the largest and most rigidly exclusive bodies of geologists in the world, came into being in 1888 as the result of a voluntary call originating from the Winchells and some others for an "assemblage of geologists" at the meeting of the American Association for the Advancement of Science, in Cleveland during the month of August. The meeting was held, a Committee of Organization appointed to get together at Ithaca in December and then, with Alexander Winchell as chairman, was delivered of the infant society of which Hall was chosen president, with Dana and A. Winchell vice-presidents and John J. Stevenson secretary. The honor came to Hall, the labor to the organizing secretary whose patience and skillful

handling guided the sturdy child on its successful career. The early days of the Society were filled with spirit, the joys of contention, honest rivalry and good fellowship — the traits of lusty growth, now too much lost in the pressure of serious concerns.

Palaeontology VI

Palaeontology Volume VI was devoted to the description of the Corals and Bryozoa, principally the latter, from the formations of the Devonian Period. It contained 298 pages and 66 quarto plates and was issued in 1887. The especially attractive feature of this book was the work of George B. Simpson, who was at first the delineator of the magnified bryozoan structures and who by virtue of the acquaintance with these objects thereby attained, became the describer and thus the virtual author of the book. These objects, minute, intricate and beautiful, were a source of great anxiety to Hall's old eyes and he called in Dr. Carl Rominger to help him out and to reassure him of the validity of his assistant's work. He never was reassured, never felt confident that the work was either wisely executed or presented an adequate survey of the field. Yet it has stood up well under resurvey and criticism and Mr. Simpson was in fact an excellent observer with extraordinary skill in delineation. To the credit of Mr. Simpson, who

was a son of Professor Hall's sister, stands his work on the anatomy of the fresh-water mussel *Anodonta fluviatilis* (published in the Museum Report of 1882), of which the distinguished and aged Isaac Lea wrote to Hall:

West End, Long Branch

Sept. 21 —

"I must compliment Mr. Simpson for having produced so admirable and perfect a paper on the *Anodonta*. It is better by far than any which have preceded it. In fact he has exhausted the subject. Agassiz states that he had examined the soft parts of 80 species of the Unionidae. I had the soft parts of 284 and stated where they were different from other species. The plates by Mr. Simpson are exceedingly well executed and the whole do great credit to your State Museum.

Very truly your old friend

ISAAC LEA

Please excuse writing with pencil. I am now well on in my 95th year.

Palaeontology VII

The seventh volume of the *Palaeontology* was concerned with the Trilobites of the Devonian rocks of New York, an interesting group to palaeontologists and particularly so to me, as my first assignment was to this work. There was really not enough of this material to make a whole volume, though we managed to bring together in this book some account of all the Devonian trilobites that had been discovered in America, and among them the highly

ornate and sometimes gigantic forms which appeared with the decline of this great group; so there was added an account of the Devonian pod-shrimps or Phyllopods which introduced a very goodly number of interesting novelties and made a notable addition to the fauna of the Devonian System of the world. Among these was the great five foot *Stylonurus* whose head, found in the Catskill Mountains, had been carried off to Rutgers College, New Jersey, but which Hall had branded with the legend of New York by describing as *S. excelsior!* This book on the Crustaceans was a substantial descriptive work which has served well, but it attempted nothing very serious in the way of classification; it did however establish some interesting facts in development or ontogeny.⁷

But still it was below the average in thickness, so its author fattened it by adding plates on the Mollusks and Annelids which were noted as supplementary to Volume V, part 2.

In some of the early American window glass

⁷ Mr. Beecher was in Albany while these studies were in progress and the ontogenic stages of *Cryphaeus* which I had brought together and illustrated excited his keen interest; so together during the open season we spent week ends in the Helderbergs searching the half silicified New Scotland limestone for trilobites of which a great harvest was reaped. It was through the sharp rivalry in these hunts and the timely discovery of a layer in which all the material of the sea bottom was delicately replaced by silica, that the material was found on which Beecher based his long continued and important studies of trilobite development and classification.

factories it was a traditional practise brought from England, to give to the workmen all that stuck to the pot when the glass was poured, so while the factory made window glass the workmen would make up their shares into bottles, vases or whatever objects pleased their fancy. It was somewhat thus with these later volumes of the *Palaeontology*: When the book had been built the apprentices helped themselves to what was left, suggestions and materials which beyond doubt in many cases led to more fruitful fields.

This volume done, Hall's plan for his *Palaeontology*, as so many times set forth to the legislature, was completed, even to the boundaries of his largest hopes. He had lived to see eleven quarto volumes published under this title and he was still a young and vigorous-hearted man of seventy-seven, alive with a strong desire to turn back once more to the years of the forties and revise the work of his youth.

But he was easily persuaded into another path. Thus far the work had been a fulfillment of a purpose to depict the fossil faunas of the New York Series of Geological Formations; now it was turned into more strictly biological and indeed philosophical channels. His vast knowledge of that group of fossils which every student of the Palaeozoic rocks must know and know well, the Brachiopoda, was now to be capitalized and projected as a revision of

the whole group. I presume he was encouraged and tempted into this undertaking by his enthusiastic assistant who did not think it necessary to stop and count the cost in view of his chief's spectacular success in meeting such situations in the past. Plans then were at once laid for a revision of the Palaeozoic genera of the brachiopods, plans which required the assemblage of really vast materials and comprehensive literature. A promise in sight, even though somewhat vague, of eventual publication, was assurance enough to take Hall promptly out through the Middlewest to every private and public collection of these fossils where he borrowed, exchanged for, bought and collected brachiopods and following his trail through the Mississippi Valley there poured into the Museum offices a steady stream of carefully selected and beautiful specimens. This was in 1889, and it was in October of that year that he stopped in Cincinnati to see a young enthusiast by the name of Charles Schuchert, whose natural impulses and surroundings had cultivated a special interest in these fossils with the help of which he had brought together an extensive and carefully identified collection, undoubtedly the best to be found in private hands in that region. Mr. Schuchert was then a sort of occasional assistant to Edward O. Ulrich of Newport, Ky., who was struggling bravely at his own cost to get a footing in his beloved science of

palaeontology by printing his own manuscripts and illustrating them at his own expense. The wonted fires blazed in Hall's veins as he looked through the drawers of Mr. Schuchert's choice specimens and he realized quickly that it was Schuchert himself he wanted as much as he did the fossils; not the things only but the man who knew the things in all their fine differentials. Would Mr. Schuchert come to Albany as his personal assistant? The State had no money but he had a little, not very much; of course Schuchert was to bring his brachiopods and let us have the use of them and of his knowledge of them. The bargain was struck right there, Mr. Schuchert agreed and was in Albany within a month (November, 1889). It was indeed a bargain, for while Mr. Schuchert was not engaged to take part in the preparation of the volumes in hand, he had vast capacity for work and was quickly rendering important service to Hall in the arrangement of his private collections, once more grown to great magnitude, and of his library whose integrity had never been impaired from the commencement of his life's work. Mr. Schuchert succeeded, in private capacity, to the position in the historic laboratory where a long line of geologists had preceded him and he was the last of that line. Many times he was sent out among the collectors of his region looking for more brachiopods for the Palaeontology or more fossils for Hall's collections, meanwhile working by him-

self on a catalogue of the American species of the brachiopods which Hall was to have printed sometime but never did. To the writer Mr. Schuchert's stay in Albany for thirty months was one of intimate and inspiring association and his departure in 1891 took away the only sympathetic soul there was in the place. Schuchert went to Minneapolis to join Newton H. Winchell, then State Geologist, in the preparation of his final reports, especially one on the Brachiopoda, of which he was author, while Winchell shared the credit. So thoroughly was his work at Albany appreciated that he was permitted to use for his Minnesota work the manuscripts, so far as they were needed, of our first volume then on the press.⁸

But while this protracted and exacting series of studies of the Brachiopoda were quietly going on in one end of the State Hall offices, and these wonderful shells were being ground and sliced and carved to bring out their intricate internal apparatus, on which, in the larger of the divisions, the generic distinctions were founded, and while all sorts of mechanical devices were contrived to elicit and depict details of extreme delicacy and significance, descriptions and essays on classification being written, draftsmen and lithographers kept supplied with

⁸ Mr. Schuchert's subsequent career, his steady climb upward in his science till he reached the Professorship in Yale University in succession to the brilliant Charles E. Beecher, are matters of contemporary achievement.

necessary materials; there was tumult and disorder at the other end of the building and it seemed at times as if Hall, growing more sensitive as he grew older, deliberately went out to seek for trouble if matters were too quiet for him. Even without his belligerent and peppery attitude toward a responsible legislative supervision of his work, a red flag was now waved in his eyes by what was construed by him as an incomprehensible persecution from his own governing board. There had come to Albany as the executive secretary of this board and successor to the ripe and wise David Murray, an up-to-date "efficiency man," with razor-like wits, a card-catalogue scheme and a ceaseless restlessness which, whether for good or evil, drives fast and hard toward distraction. On this almost octogenarian savant there was turned a barrage of unfamiliar attack. The hours of daily work must be accounted for, progress must be shown, financial responsibility must be surrendered, contracts revised and overturned; in other words the Palaeontology of New York was to be put on a business basis. It could not be; it never had been and never should be; and indeed would never have been proposed had there been behind this procedure any understanding of what science means or how scientific research is done. How often was I snatched from the spirals of a new and wonderful brachio-pod to rush off to interview, on behalf of my chief

in his distress, Martin I. Townsend or Hamilton Harris or Andrew S. Draper, Regents of the University, and get their comment on some new explosion. Soon fires which had smouldered so threateningly broke out in open blaze to fill the local newspapers with thrust and parry and counterthrust. The rapid-fire secretary overshot his mark and created a situation which the Legislature of the State could not fail to take notice of. Hall's friends in the Senate demanded an investigation of the Regents' administration of these scientific affairs and a committee of wise Senators imbued with the utmost good nature and patience, entered upon an inquiry into the historical and actual administration of these matters, hoping for and seeking peace, disproving and dismissing the hot-headed charges of malversation against Hall, and recommending in their report modifications of supervision which led easily to the event of 1893. The event of 1893 was the passage of a law which empowered the Governor to reappoint Hall, State Geologist and Palaeontologist for life, with full and independent management of his appropriations and his scientific business. In spite of all protests from the Regents, Governor Flower recommissioned Hall with the same title that, and a greater authority than he had received with his appointment from Governor Marcy in 1837, fifty-six years before. It was an unprecedented occurrence and brought to Hall tem-

pestuous congratulations, not only from a multitude of scientific friends throughout the land, but a shower of plaudits from those nearer home who had watched the undignified attacks upon him with entire disapproval. It was in vain that in succeeding years the Regents' Secretary tried to secure a repeal of the enactment. It remained in force throughout the remainder of Hall's life and in his joy over his release from captivity Hall presented to his friend the Honorable Danforth E. Ainsworth, Speaker of the Assembly, a gold medal commemorative of the service rendered. It was all done without politics; a Republican Speaker prepared the way for action by a Democratic Governor.

The whole procedure had been a horrid phantasmagoria, a weird atmosphere indeed in which to render one's devotions to science, and I dare not say if, in the bewilderments of those days, some brachiopod genus did not get a few more whorls on its brachial supports than it was entitled to. Out of the smoke of battle the victor emerged, the Governor's commission under his arm, with elastic step and heightened vigor. The powers of darkness had been dispelled and in the vicissitudes of a scientific career, virtue had won. The remnant of the scientific organization under the Regents was now a feeble thing, hopelessly wounded and Hall had already withdrawn from association with it by retiring from its directorship. But a deeper blow

than we thought had been dealt, and soon there appeared in far off Paris, in the columns of *Le Temps*, a "news" item under conspicuous headlines, declaring that James Hall, a noted American savant, had been convicted of stealing scientific property belonging to the State and was now incarcerated. This hideous thing, copied freely by Continental papers, was a blow that seemed to be aimed at the aged man where his pride was tenderest, for he ever looked to France as the country where his labors were best known and appreciated. To me this scandalous tale called for bitter and quick resentment, for indeed the story carried the additional statement that Hall had been in the way of receiving *pots-de-vin* from his assistants. Strangely enough, while I hurried to get from the Chancellor of the Board of Regents, Anson J. Upson, a signed and forcible denunciation of this baseless libel and transmitted it with full denials to the offending sheet, Hall seemed to take it all stolidly and even, I thought, to carry an inscrutable smile over the French picture of himself in a felon's cell. With usual journalistic ethics the Paris editor printed the Chancellor's letter and my own, adding thereto the remark that his information had been obtained from a reliable source — the *Kölnische Zeitung*, as it turned out to be! Presently the New York State Legislature, taking official notice of this affront, passed a concurrent resolution expressing in chosen

superlatives their entire confidence in the victim of this attack and transmitted it to Hall beautifully engrossed. Then the French savants became active. First came the Société Géologique du Nord with an address of regret and confidence, signed by all its officers. "My compatriots," wrote Barrois, "are furious at the calumny; you have now united the palms of martyrdom with those of victory. No geologist has accomplished more than yourself in this century for your science and for your country." Daniel-Pauline Oehlert,⁹ of Laval, declares "as the spokesman of the Geologists and Palaeontologists of France," that the odious attack has in nowise "lessened our reverence for your high scientific work and your life which has been devoted to the service of science." Then came a formal address from the Société Géologique de France, which was soon after followed by the extraordinary honor of Hall's election to the Vice-presidency of that Society. Thus, it seemed, the stage was unconsciously but most effectively set for the final triumphal act which was presently to follow, and I have often thought of that prescient smile hidden away in Hall's snowy whiskers when the French villification fell upon him.

Meanwhile out of all this smudge came the final two volumes of the "Palaeontology of New York" on the Genera of the ancient Brachiopods, soon to be

⁹ Died September, 1920.

followed by plaudits and gracious approval, which I am sure sunk deeper into the consciousness of the junior worker than in the more toughened sensibilities of the senior.

Barrois writes: "It is the best and most complete [work] ever written on invertebrate fossils." "You have made so much progress in this branch that the study of the Palaeozoic Brachiopoda has become altogether a new field."

H. B. Geinitz of Dresden writes: "You have now brought your splendid work to a close in the most magnificent manner."

Lesley wrote in 1892: "I have been reading this evening the prolegomena of your beautiful Vol. VIII, part 1, for which let me thank you with all my heart."

The books have indeed served well and have played the part of parent to much suggestive work in the same field, like that of Beecher and of Schuchert. It is the fate of comprehensive undertakings of this sort that they are soon absorbed as fundamental knowledge and the personal responsibility of authorship is lost sight of. The author has ceased to be an individual and become an institution upon whose foundations others build.

Having gone so far in research amongst the Brachiopods of the Palaeozoic rocks, it seemed an opportune occasion for the State of New York to openly declare that its scientific functions are not

restricted to State boundaries, and so there soon appeared a "Handbook of the Genera of the Brachio-poda," in two smaller volumes, into which were covered all genera of the entire group, fossil and living. This was profusely illustrated and constituted the only attempt ever made under Hall's régime to cover even on broad lines an entire biological unit. Though the "Palaeontology," as such, was closed and done with, these volumes were like an echo from the last tones of its great bell.

The Later Geology. Until he had become involved in the production of the State Map, which was finally published in 1894, Hall had persistently put aside more strictly geological pursuits. He had no time for them and was frankly annoyed when they were too closely pressed on his attention. His own knowledge was abundantly sufficient to meet all demands that came to him in the course of his official business and he was uneasy over opening new leads in this field as he seemed to know to what expenditures of care and money they might tend. The building of the map however had made a start necessary in several directions and now he began to feel the need of adjutant help in seeing such projects through. In 1891, D. Dana Luther, a miller, who had quietly pursued his business with the study of the geology of his home town of Naples, N. Y., was engaged to keep the geological records of the salt mine which was being

put down through the Devonian and Silurian rocks at Livonia, in western New York, and with this successfully done and an inch-by-inch log made of the rocks and faunas, he gradually and cautiously widened his field of labor among the palaeozoic rocks until at his retirement from active service twenty-five years later, he had surveyed and accurately charted for the great geological map of the State, a larger area than has been covered by any other man. It was in 1893 that Professor James F. Kemp, of Columbia University, proposed concerted work with C. H. Smyth, Jr., of Hamilton College (now of Princeton University), and Henry P. Cushing, of the Western Reserve University, Cleveland, upon the complex problems of the Adirondack crystallines — a most involved field and one exacting the best training and ability in petrological geology. Again and again it had resisted the desultory efforts of one and another geologist and the various attempts to express its structures in terms of probability or of correspondence with the inferences of the Canadian geologists from their greater expanse of these most ancient and disordered rocks.

This proposal afforded Professor Hall very great satisfaction for he knew, without power to solve, the mystery of this mountain area where he had done his first official work, and he held out to Professor Kemp and his colleagues all the encouragement he had at his command. From this beginning



Standing in front of his house, 1895

the Adirondack work has gone on to most satisfactory results, Professors Kemp and Cushing still actively interested in the field and the latter having published a comprehensive *Geology of the Adirondacks*, while competent younger men have come in to carry the investigations forward.¹⁰

It was in 1891, that Edward Orton, of Columbus, long eminent for his educational and geological service in Ohio and then deeply concerned with the new problems of petroleum and natural gas, entered upon a survey of the oil and gas fields of New York, his native State. Hemiplegic and lame as he was, he took the field with an unabated enthusiasm and kept at his important work for several years. Thus with geological work progressing both in the crystalline and the sedimentary rock regions of the State, the organization had once more resumed its proper title of the Geological Survey of New York, a title never lost from the days of 1836, though submerged for many decades. And the reports coming in from many workers¹¹ created colossal volumes for the official annual reports of the State Geologist.

¹⁰ Since this was written, Professor Cushing, after twenty-eight years association with the difficult Adirondack problems, has passed away.

¹¹ Among the geologists of these years in the New York field are the names of Irving P. Bishop, E. R. Cumings, Henry P. Cushing, Nelson H. Darton, William B. Dwight, James F. Kemp, D. Dana Luther, Edward Orton, Charles S. Prosser, Heinrich Ries, Clifton J. Sarle, John C. Smock, C. H. Smyth, Jr.

International Congress.

The meeting of the International Geological Congress at Washington in the late summer of 1891, the only time it has come together in the United States, brought a large number of distinguished geologists together, many of whom came to pay their respects to Hall in advance of the meeting. Hall was not very well at the time, so he fled the town at their appearance and left it to me to provide such entertainment as could be afforded. Kayser of Marburg, Schmidt of Basle, Frech of Breslau and Friedrich Schmidt of St. Petersburg, came on together and with them came the rains, but into the Helderbergs we went trying to get and give some idea of their structure and contents, though it was pretty dreary business through this land of evil country hotels (as it was then) and the guests soon went their ways into the west. Hall came back as soon as they were gone and Friedrich Schmidt, fine and vigorous old Russian and academician, got no further than Utica, when he turned back too, his Russian thirst unslaked, and determined to test the merits of those spirits in the cellar of Hall's workshop of which he seemed to have instinctive knowledge.

So he stayed and mellowed awhile letting his colleagues go on, while he poured out the vials of his great knowledge and enthusiasm to the inspiration of us all. When the meetings convened Professor

Hall was among its honorary presidents, and while he did not take any active part in them he was made conscious of the regard in which he was held by his colleagues from all the world by the presentation of an engraved salutation:

To the Nestor of American Geologists, an original member and moving spirit of the Comité Fondateur of the International Congress

PROFESSOR JAMES HALL,

Whose presence is an honor and an inspiration

The members of the

Fifth International Congress of Geologists

Assembled at Washington, A. D., 1891

Give special greeting.

To this was attached a distinguished group of signatories, men honored, if now living, venerated if gone. Among them were

Barrois	Gaudry	Rothpletz
Marcellin Boule	McKenny Hughes	Rathbun
Branner	Harker	Reusch
Whitman Cross	W. H. Holmes	F. Schmidt
W. B. Clark	Holst	Tschernyschew
T. C. Chamberlin	Jaekel	Stefanescu
F. W. Clarke	E. Kayser	Streng
Credner	Lundholm	Stainier
del Costillo	M. Lohest	C. Schmidt
DeGeer	de Margerie	C. A. White
Fairchild	McGee	Walcott
Frech	O. C. Marsh	Wahnschaffe
Theo. Gill	Powell	L. F. Ward
Gilbert	Pumpelly	von Zittel
Henry Gannett		

Honors at His 60th Official Anniversary.

Mrs. Hall, whose interest in her husband's work, so strong in the early years of their long married life, had long since given way to religious devotions, died in 1896. Their eldest daughter, Josephine, of whose personal beauty and attractiveness stories are still told in Albany, had married Thomas B. Bishop, a graduate of the Albany Law School, and they had settled in San Francisco, where Mr. Bishop had achieved distinction and wealth. Returning from Albany after her mother's funeral Mrs. Bishop took her father back with her to San Francisco and it was during this absence that Mr. Hall's friends in the east, led by W. J. McGee, arranged a celebration of the sixtieth anniversary of his appointment to the geological service of New York, to take place on the occasion of a joint meeting of the American Association for the Advancement of Science and the Geological Society of America, at Buffalo, to be held in August.

Hall was enjoying himself on the Pacific Coast with his four strapping Bishop grandsons, with visits from Branner of Stanford University and with the rest which so complete a change could give. It was something of a risk for him to come across the desert in August, but he generously took the risk at the solicitation of his friends and came back over the long journey, turning up in Buffalo on a

broiling August 26th, the coolest and most serene among all the large assemblage which had gathered in his honor. The occasion was effective and expressive. Professor Benjamin K. Emerson, the vice-president for the Geology Section of the Association, opened the ceremony with a graceful tribute and introduced the distinguished Joseph Le Conte, of the University of California, then president of the Geological Society of America, who rendered homage in impressive phrases:

“Sixty years of unremitting labor, of unswerving purpose directed toward one end and that the noblest! Is not that the definition of a great work; more of a great life; still more of a great man? * * Surely in an important sense he may be called the *Founder of American geology*. * * He alone not only laid a foundation as others helped to do, but has continued for sixty years to build thereon a solid and beautiful edifice.” * *

“I have spoken thus far of Hall the geologist; now a single word, in conclusion, of Hall the man. Greater than all the results of science is the true spirit of science which accomplishes these results. So, greater than all Hall’s work, great as this is acknowledged to be, is the character of the man, and the man himself. Hall is an example to us all in his unswerving, incorruptible, self-sacrificing devotion to pure science for its own sake. In this age of profitable science, and even often of science for profit, we can not too highly value such an example. But if the man determines the character of the work, the work also reacts to determine the character of the man. A great man is necessary for a great work, but a great work continued

through life reacts to ennoble and elevate the man, and even illumines the face with a higher intellectual and moral beauty. As Dante, while gazing steadily on ideal beauty in the face of the divine Beatrice, is drawn upward to the seventh heaven, even so the man of science, gazing steadily on the face of Truth, is drawn upward to higher and higher planes of intellectual and moral elevation."

Others followed with essays on various features of Hall's work: Mr. McGee, Mr. Clarke, Professor Stevenson, George M. Dawson, T. Guilford Smith of the Board of Regents, who liked to stand in the shadow of Hall's name, but whom the venerable Professor thought it "not prudent to encourage" on this occasion. To all these tributes Hall responded modestly and deprecatingly, but the deference shown him struck a ringing cord of memory and he spent the evening of this day in the hotel telling me stories of his early years, most of which are incorporated in this narrative.

Journey to Russia and the Seventh International Congress of Geologists, 1897.

Old Russia, High Patroness of Science and of intellectual fecundity, brilliant as ice in the culture of her Academic circles, had extended her invitation to the geologists of all the world for a meeting at St. Petersburg in the summer of 1897. The lure was strong to every devotee of the science but it seemed to come to Hall as though he were an aspiring

acolyte rather than, at 86, its most venerable and probably most distinguished living exponent. He looked rightfully upon the Congress as in some good measure his child but it is quite certain he would hardly have seriously ventured upon this distant journey toward "the mists which brood upon the northern fjords" had it not been for the insistence of his daughter, Mrs. Bishop, who promised to accompany and take care of him. There was much that was brave and some that was humorous in his final determination to go. He had been "a dying man for fifty years," quoth his physician. To those working with him it seemed that he found some physical ailment "new every morning and fresh every evening," but now having gone to Dr. Hun he reported to me with pride that in him no organic impairment of any kind had been found and his physician advised him to go. This distant cruise was his triumphal progress, his apotheosis. Everywhere among the circles of geologists on the long route thither and back he was royally acclaimed by ancient colleagues, of whom alas! but few were left; by the younger admirers and by the novitiate of the science who must have regarded him as a priest after the order of Melchisedek, without beginning or end. But he had not gone simply to be gazed upon as a Greek urn or a *fait accompli*. Hall still belonged to the living present and from his port of Hamburg he made his way straight to Stockholm,

spent a day with Lindström amongst his fossil corals, and thence under the guidance of Holm explored the classic rock section of Kinnekulle where Linné had labored a century before, had dinner in a grotto in the Orthoceratite limestone, the next day explored a section extending from the granite upward to the Reteolite-shale; and then under the guidance of Dr. Mundte went over to the island of Gotland and its rocks. It was natural that he should write to me, after the visit: "Could we have had a complete knowledge of these sections when we began or even when we ended our first four years of work in New York, it would have greatly facilitated our proper interpretation of the older rocks in America;" perhaps forgetting in writing this, that the same fifty years which had clarified the rock succession in New York, had done the same for Sweden.

When, at St. Petersburg, the sessions of the Congress began at intervals in the brilliant round of entertainment, Hall, an *ancien président*, high on rostrum and dais, was the star in that Ursa Major, the cynosure, which drew the attention of all eyes, easily the most striking figure there and the unfailing pride of his countrymen who had gathered there in no small number. The meetings over, he went to Moscow, and from there, abandoning a proposed journey to the Caucasus, he traveled to Vladikavkaz and on horseback across the mountains to Tiflis,

thence to Batum and by Russian steamer to Odessa and Sebastopol. Fourteen days brought him by an Italian steamer to Naples with two days in Constantinople. From there his family party moved leisurely by Rome, Florence to Paris, Southampton and home. While in France, Barrois had arranged a special meeting at Lille of the Société Gèologique du Nord at which Hall was to preside and the Paris friends had hoped to give him a reception at the Académie des Sciences, but he missed the latter, and Gaudry writes to him:

Museum
of Natural History
Palaeontology

November 6, 1897.
Clugny, Versailles.

Dear Master:

I think that my letter addressed to the Hotel Foyot has already reached you. I regret that you did not come to the sitting of the Academy last Monday. M. Bertrand, De Lapparent and myself expected you; we would have been happy to behold among us an illustrious correspondent of the Institute, one who has accomplished so much for Geology and Palaeontology.

Madame Albert Gaudry and myself would have been proud and happy to have you in the country, with Madame your daughter and her children. But we feared to commit an indiscretion in asking you to come when the weather was so cold, and in monopolizing a few of the brief moments of your stay in Paris. We hope that your health, so precious to science, has not suffered from all the fatigues of your great journey; you have given to all an example of devotion to Geology. It will be a great happiness to us to

see you back in Paris in 1900, at the Exposition Universelle. My wife prays you to remember her to Madame your daughter.

Please, dear Master, accept the assurances of my most respectful attachment.

ALBERT GAUDRY

The Story Draws to its Close.

Mr. Hall came back from his grand tour in excellent physical condition and spirits. Even his younger companions were tired by the strenuous efforts required to keep pace with the royal hospitality of their reception in Russia. But he had withstood them all and for the winter of 1897-8 he lived upon the memories of his tour, the acknowledgments and the salutations which had thronged upon him, and in fulfillment of promises he had given to one and another for materials and books. Yet, as the months went on, it became quite obvious to those about him, now that his daughter had gone back to her distant home and he was once more quite alone in the world with no one near who belonged to him to break the solitudes of his life, that he was himself seeing the end of his career. He was nearing his 87th birthday, he could not in reason look for much more time to work or more work to do. He knew that his apotheosis had come to him while living. So he quietly awaited his end, seeing it not afar off, but viewing its approach with complacency and with such diversions as his fossils and his cor-

respondence could afford. Even into July of 1898 he was sending corals to Lindström in Stockholm and carrying on a correspondence with Professor Samuel Calvin of Iowa over the same subject. Lindström wrote to him (July 27) acknowledging his favors and added: "You have behind you a long and honorable lifetime of more than fifty years of scientific labours and how many are there who can say as much? Your *Palaeontology of New York* will be consulted for ages to come by many generations of Palaeontologists, American and European."

And among his last letters came one from his friend of many years, Dr. David Murray, a former secretary of the Board of Regents, against whose successor in office Hall had waged such hard battle: "I think with profound admiration of the patient life of investigation and study you have spent. I have often said that I regard you as the most learned man I have known."

It was a pathetic life he was now leading in his absolute solitude, his two sons estranged, his two daughters, one distraught and one far off; ministered to about his home on the Beaverkill by none too loyal hands; nothing was left to him but his fossils, his books, his memories, his real and his fancied troubles.

Often to escape the summer's heats, Hall had been in the way of going for short visits to familiar spots

not far away, to Schoharie or into the Helderbergs or to the coast of Massachusetts. Once or twice he had visited Echo Hill, near Bethlehem, New Hampshire, and he liked the quietude of the place. So thither he went, not in the most vigorous physical state and obviously depressed in spirits, taking along with him amongst various proof sheets and manuscripts an ill-conceived and nerve-racking screed which he would make into an indictment against a former assistant. On the morning of the 6th of August, his nurse had laid upon his stand a bowl of broth and he promised to rise and drink it, but she had no sooner left the room than she heard a fall on the floor and turning back found the venerable savant, the aged oak, lying dead where he had fallen.

Thus he went alone, quickly and without pain or mental impairment. And thus passed from life a very great man, not honored in his family, not well understood in his own community, not always courteously entreated and appreciated by his scientific contemporaries; but on the other hand winning the admiration and acclaim of those great-minded enough to understand his inflexible purpose and the magnitude of his achievement.

Professor Hall's body was brought to Albany by his faithful secretary, Jacob Van Deloo, who went at once to Echo Hill, and his funeral added one more pitiful touch to this earthly career. But this part

of his story it might be unseemly to record. The aged professor had so outlived his generation that but a handful were gathered at the church and he was borne to his burial by a few who had been summoned to represent, on this last occasion, the science he had so deeply loved and so long served among them: Grove K. Gilbert, Benjamin K. Emerson, William H. Niles, Albert S. Bickmore, Edward O. Hovey.

HALL'S INFLUENCE ON SCIENCE.

The story we have written has had for its burden this very theme in its personal setting and background. But we may appropriately sum up the matter in epitaphic form. James Hall was a pioneer, taking the best knowledge of his day for the foundation of his work. Quickly and keenly he enlarged and built upon it. No one in America had caught and interpreted the meaning of the stratigraphic record as he did in his great volume of 1843. He was indeed, as McGee had called him, the Founder of American Stratigraphy. And we are not using this term in the same sense as it is commonly employed in referring to the much earlier work of William Smith, to whom must forever go the honor of establishing identity of geological chronology by identity of fossils. The present school of students of sedimentation which is disposed to weigh more carefully new found distinctions in lithology re-

gardless of fossils, will do well to read over the volume referred to and see how far Hall opened the door to this phase of the modern science. In palaeontology Hall ever kept the geological side of the science uppermost; from its beginnings on to near the end of his life, its purpose was never philosophical though importantly biological, but fundamentally the establishment, through profusion of evidence, of the New York Series of Geological Formations. Thus throughout his productive career he was unfailingly loyal to the impulses he had acquired from the days of 1836-43, and the purpose of the men who made the first geological survey of the State. This book will have served some part of its purpose if it reminds the present and the coming generations of geologists that Hall has showered upon them, like the gold of Danae, facts and associations of facts, conclusions and the modes thereof which are now the common possession of the science, but for which, if thoughtless of the fathers and founders, they should send upward their recognition. It is thus that all scientific details fit into the general framework of knowledge and soon cease to be recognized as either a monument to their discoverer or their creator. Hall's treatise on mountain making was splendidly fortified deduction, lightly eschewed by those whose theories have chosen to take another course, but magnified and still acclaimed by others who see in it a *causa*

causans amid the complex forces engaged in crustal changes.

It would be a grave error to perpetuate Hall's memory and associate his work as limited by his official relations with the State of New York. His influence guided official geological movements in every state where they were inaugurated and in many his own hand took a helmsman's part. His books drove many an enthusiastic collector and budding student out in among the rocks to find for themselves the things he had depicted; the influence he thus exerted gave creative impulse to study and research which can in no way be estimated, for he was in truth the apostle of historical geology in America without whose labors, as James D. Dana wrote in inscribing to him a copy of his last "Manual of Geology," "the geological history of the North American Continent could not have been written." To those who have pursued geological science after the mode of Hall's days, who have continued to regard the study of the ancient simple life of the earth, its relation to the seas and the lands, its lights upon the revolutions in our geography; the influence of the man and his work is still a living factor and must continue to be, as his seed has been sown on good soil and has produced a vast harvest.

HONORS

- 1832. Bachelor of Natural Science (B.N.S.) Rensselaer School, Troy, N. Y.
- 1833. M.A. Rensselaer School, Troy, N. Y.
- 1836. Assistant Geologist on the New York Geological Survey. Appointed by Governor William L. Marcy.
- 1837. Principal Geologist and assigned to the Fourth Geological District of the State. Appointed by Governor William L. Marcy.
- 1837. Imperial Society of Mineralogy, St. Petersburg, Russia. Actual member.
- 1842. Honorary M.A. Union College, Schenectady, N. Y.
- 1843. Palaeontologist of New York in place of Timothy A. Conrad, resigned. Appointed by Governor William C. Bouck.
- 1843. Academy of Natural Sciences, Philadelphia; correspondent.
- 1844. American Philosophical Society, Philadelphia; member.
- 1845. Honorary M. A. Princeton College.
- 1845. Société Géologique de France; member.
- 1846. Honorary M.D. University of Maryland.
- 1848. Geological Society of London. Elected one of the fifty foreign members.
- 1848. American Academy of Arts and Sciences; fellow.
- 1850. Judge at the Provincial Exhibition, Montreal.
- 1851. Professor of Mineralogy and Geology, University of Albany.
- 1852. New York Lyceum of Natural History; honorary member.
- 1854-1876. Professor of Geology, Rensselaer Polytechnic Institute.

- 1755. K.K. Geologische Reichsanstalt; member.
- 1855. State Geologist of Iowa; appointed by Governor James Wilson Grimes.
- 1855. Gesellschaft für Natur und Heilkunde, Dresden; member.
- 1856. Natural History Society of Montreal; honorary member.
- 1856. President, American Association for the Advancement of Science.
- 1856. Academy of Natural Sciences, St. Louis; corresponding member.
- 1857. Appointed by Act of Legislature of Wisconsin, one of the Commissioners to make a Geological and Agricultural Survey of Wisconsin.
- 1857. Société Royale, Liège; corresponding member.
- 1857. State Historical Society of Iowa; honorary member.
- 1858. Geological Society of London; awarded the Wollaston Medal and proceeds of the Wollaston Fund.
- 1859. Societas Cæsarea Naturæ Scrutatorum Mosquensis; member.
- 1859. Chicago Academy of Sciences; corresponding member.
- 1860. By Act of the Legislature of Wisconsin, constituted and appointed Principal of the Geological Commission established by chapter 40 of the laws of 1857.
- 1860. Die Naturhistorische Gesellschaft, Nuremberg; corresponding member.
- 1860. Die Naturforschende Gesellschaft, Basle; corresponding member.
- 1862. Portland Society of Natural History; honorary member.

- 1863. LL.D. Hamilton College, Clinton, N. Y.
- 1863. Buffalo Society of Natural Sciences; honorary member.
- 1863. Named by Act of Congress, one of the fifty charter members of the National Academy of Sciences.
- 1867. Academy of Natural Sciences of Philadelphia; Conchological Section; member.
- 1870. New Orleans Academy of Science; corresponding member.
- 1872. British Association for the Advancement of Science; member.
- 1873. Société Royale des Sciences, Liège; corresponding member.
- 1873. Minnesota Academy of Natural Sciences; honorary member.
- 1874. Société Géologique de Belgique; member.
- 1876. Rensselaer Polytechnic Institute; professor emeritus.
- 1878. President of the Albany Institute.
- 1878. Vice-president of the International Congress of Geologists at Paris.
- 1879. Academia Cæsarea Leopoldino-Carolinæ Germanicæ Naturæ Curiosorum; member.
- 1881. Vice-president of the International Congress of Geologists at Bologna.
- 1881. Ricordo de Benemerenza; awarded by the International Congress of Geologists.
- 1882. Title and Decoration of Commander of the Order "Dei Santi Maurizio è Lazzaro"; conferred by the King of Italy.
- 1883. Acad. Valdernes del Poggio, Italy; corresponding member.

- 1884. Walker Quinquennial Grand Prize of \$1,000 awarded by the Boston Society of Natural History.
- 1884. LL.D. McGill University.
- 1884. Institut de France, Acad. des Sciences; correspondent.
- 1885. Vice-president of the International Congress of Geologists at Berlin.
- 1885. Königliche Gesellschaft der Wissenschaften, Göttingen; member.
- 1886. Natural History Society, Montreal; honorary member.
- 1886. Austro-Hungarian Geological Society, Budapest; honorary member.
- 1886. LL.D. Harvard University.
- 1887. Académie Royale de Belgique; member.
- 1887. Société Belge de Géologie, de Paléont. et de Hydrologie; honorary member.
- 1887. Essex Institute, Salem, Mass.; honorary member.
- 1889. R. Institute Venete di Scienza, Lettere e Arti; corresponding member.
- 1889. First President of the Geological Society of America.
- 1890. Hayden Medal and Proceeds of the Fund, awarded by the Academy of Natural Sciences, Philadelphia.
- 1890. American Association for the Advancement of Science; honorary fellow in recognition of 50 years of membership.
- 1891. International Congress of Geologists at Washington; address signed by all members present.
- 1892. Boston Society of Natural History; honorary member.

- 1894. Accademia royale dei Lincei, Rome; member.
- 1896. Société Géologique de Belgique; congratulations on 60th anniversary.
- 1896. Vice-president, Société Géologique de France.
- 1897. Delegate from American Association to the International Congress of Geologists at St. Petersburg.
- 1897. "Ancien président honoraire" of the International Congress of Geologists, St. Petersburg.
- 1898. Ural Society of Natural Sciences; honorary member in place of Sir Roderick Murchison.

INDEX

A

Adams, C. B., 148, 173
 Adirondack Survey, 59
 Agassiz, Alexander, 384, 463
 Agassiz, Louis, 81, 82, 86, 151, 153, 168, 171, 183, 187, 205, 210, 219, 254, 272, 377, 414, 462
 Ainsworth, D. E., 531
 Alabama, University of, 152, 180
 Albany Academy, 35, 50, 191, 258
 Albany County, geological survey of, 27
 Albany Evening Journal, establishment of, 271
 Albany Female Academy, 74
 Albany Institute, 49, 50, 253, 341, 366, 414, 417, 442
 Albany Law School, 202
 Albany Medical College, 191, 192, 244
 Albany Normal School, 262
 Alvord, Thomas G., 466
 American Association for the Advancement of Science, 52, 100, 102, 103
 American Association of Geologists and Naturalists, 102, 134
 American Geological Museum, 188, 189
 "American Geological Society," 255
 American Geologists, Association of, 101
 American Geologists, Society of, 52
 American Institute of the City of New York, 49
 American Museum of Natural History, 464
 Anderson, Martin B., 383
 Anderson, Sir James, 393, 395
 Andrews, E. B., 298
 Andrews, William A., 340
 Anesthetization, discovery of, 218
 Antarctic Exploration, 56
 Anticosti Island, 307
 Anti-Masonic interests, 271
 "Antirent War," 149
 "Appalachian System," 459
 Appleton, Nathan, 229
 Appleton, William, 229
 Armsby, Dr. James M., 133, 190, 274, 318
 Association of American Geologists, 101
 Association of American Geologists, and Naturalists, 102, 139
 Ast, Philip, 407, 409
 Astronomical Expedition to Chile, 181
 Atlantic Cable, laying of, 394

B

Bad Lands, 245
 Bagg, Egbert, 38
 Bailey, Jacob W., 139, 171, 178, 194, 323
 Bailey, Loring W., 325, 418
 Bailey, Whitman, 418
 Baird, S. F., 440
 Bakewell, Robert, jr., 112
 Barker, George H., 457
 Barnard, F. A. P., 467
 Barrende, J., 346, 476, 477, 507
 Barris, W. H., 235, 274
 Barrois, Charles, 486, 487, 504, 533, 534, 539
 Bath, Countess of, 66
 Baumhauer, 479, 481
 Beaver Park, Albany, 236
 Beaumont, E. de, 352, 399
 Beck, Lewis C., 50, 133, 191
 Beck, Theodor Romeyn, 29, 50, 133, 140, 182, 196, 201, 274
 Beckles, 347
 Beech, Nelson J., 182
 Beecher, Charles E., 415-417, 490-494, 524, 528, 534
 Beecher, Lyman, 19
 Bell, A. Graham, 498
 Benedict, Lewis, 271, 272, 274
 Benton, E. R., 258
 "Berkshire Boulder Trains," 255
 Bethel, 73
 "Bible and Science," 264
 Bickmore, Albert S., 463, 465, 549
 Bigsby, J. J., 347, 398, 430, 438
 Bigsby Medal, 436
 Billings, Elkanah, 306
 Binney, Amos, 22, 23
 "Bird Tracks," 87
 Bishop, I. P., 537
 Bishop, Thomas B., 540
 Bissell, Gov. William H., 283-285
 Blanford, W. L., 506
 Blainville de, 83
 Board of Geologists, 52, 99, 100
 Bologna Congress, 504
 Bonaparte, Charles, 169
 Bonaventure Formation, 422
 Boss, Benjamin, 202
 Boss, Lewis, 202
 Boston "episode," 125
 Boston Society of Natural History, 20, 22, 134, 227, 256
 Bouck, Gov., 132, 134, 137, 184
 Boule, M., 539
 Bounty Lands of Central New York, 65

- Bouvé, Thomas T., 20, 178
 Bowerbank, J. S., 431
 Boyd, George W., 56
 Boyle, Sir David, 471
 Boynton, John F., 440
 Branner, John C., 426, 539, 540
 Brazilian geology, 425, 427, 428
 Brevoort, J. Carson, 385
 Briggs, Caleb, Jr., 90, 91
 British Museum, 88
 Bronson, Greene C., 190
 Brooks, Mrs., 180
 Brooks, T. B., 423
 Brown, Gov. B. Gratz, 454
 Buckland, William, 40, 106, 432
 Burning of Beecher's Church, 19
 Burning of the "Henry Clay," 235, 325
 Bush, E. G., 402
 Busk, George, 436
- C**
- California geology, 299
 California, Government Mission to, 131
 California schemes, 181
 Calloway, Charles, 417
 Calvin, Samuel, 547
 Canada, Geological Survey of, 301
 Canadian Naturalist, 306
 Canino, Prince of, 169
 Capellini, 393, 480, 504
 Cardiff Giant, 438-443
 Carley, J., 87
 Carll, J. F., 457
 Carpenter, W. B., 431
 Carr, Ezra S., 56, 173, 286, 289
 Carruthers, W., 435
 Castleton, Vt., Medical School, 31
 Catskill Division, 97
 Catskills, survey of, 27
 Celebration of Sixtieth Official Anniversary, 541
 Chamberlin, Thomas C., 287, 481, 539
 Chambers, Robert, 437
 Champlain Division, 97, 157
 Charleston Medical College, 193, 208
 Chase, Gov., 298
 Chicago in early days, 31
 Christy, David, 87, 242
 Civil War, 395
 Clapp, Dr., 87
 Clark, Gov. Myron H., 318, 382
 Clark, Joseph, 87, 150
 Clark, W. B., 539
 Clarke, F. W., 539
 Classification of the Formations, 97
 Claypole, E. W., 513
 Cleaveland, Parker, 40
 Clinton, DeWitt, 27, 50
 Clinton, George, 385, 391
 Coal, age of, 42, 75-80
 Cogswell, F. G., 288
- Cohoes Mastodon, 386
 Collections and collectors, 85
 Collections, early, 44
 Collett, John, 509, 510
 College of Physicians and Surgeons, Fairfield, 37, 50
 "Colonies," 371, 372
 Colorado Exploring Expedition, 298
 Colquhoun, Patrick, 66
 Colton, Josiah, 210
 Comstock, T. B., 426
 Connecticut Valley bird tracks, 87
 Conybeare, 106
 Conrad, Timothy A., 53, 54, 62
 Continuity of life, opinions on, 1843, 82
 Cook, George H., 30, 191, 208, 296, 457, 481
 Cooke, Caleb, 419
 Cope, E. D., 438, 481
 Copper Harbor, expedition to, 146
 Cornell University, founding of, 423
 Corning, Erastus, 385, 461
 Costillo, del, 539
 Cotting, John, 124, 132
 Country Gentleman, 175, 191
 Country lectures, 43
 Courts and Science, 212
 Cox, E. B., 481
 Credner, Hermann, 398, 539
 "Crevice Maps," 362
 Cross, W., 539
 Crystal Palace exhibition, 257
 Cumings, E. R., 537
 Cunard, Edward, 319
 Curtis, George William, 424
 Curtiss, T. B., 230
 Cushing, Caleb, 144
 Cushing, Henry P., 536, 537
- D**
- Dana, James D., 37, 45, 53, 99, 139, 140, 209-215, 318, 384, 551
 Daniels, Edward, 287, 289
 Darton, Nelson H., 520, 537
 Darwin, C., 108, 140
 Davidson, Thomas, 364, 434
 Davis, William M., 278, 514
 Dawkins, W. B., 431
 Dawson, George M., 192, 542
 Dawson, Sir William, 366, 367, 433, 435
 Dean, Amos, 190, 191, 208, 273, 319
 Dean, Chancellor University of Iowa, 210
 Death of Agassiz, 462
 " " Barrande, 507
 " " Desor, 515
 " " Hall, 548
 " " Henry, 487
 " " Hodge, 149
 " " Houghton, 148
 " " James Eights, 56
 " " Vanuxem, 55

DeGeer, G., 539
 De la Beche, 156, 302
 Derby, Orville A., 412, 426
 Derby School, 15, 22
 Desor, Edouard, 172, 198, 219, 351,
 445-447, 475, 476, 483-485
 Detroit, 86
 Detroit as a military post, 31, 33
 Development studies, 495
 Devonian brachiopods, 406
 Devonian forest, 460
 Devonian plants, 399
 Dewey, Chester, 38, 269, 321
 Dick, Robert, 40, 41
 "Dictionary of Fossils," 516
 Directorship, Geological Survey of
 Canada, 118
 Dix, John A., 49, 59, 134
 d'Orbigny, Alcide, 136
 Doctor of Medicine, Hall, 43
 Dourdain, Susanna, 11
 Downing, Andrew J., 235
 Draper, Andrew S., 497, 503, 530
 Dudley, Mrs. Blandina, 197, 202,
 320
 Dudley Observatory, 194, 202, 240,
 319
 Ducatel, Dr., 88
 Dwight, W. B., 537

E

Eaton, Amos, 25-29, 35, 38, 42, 49,
 53, 69, 89, 117
 Eaton, James R., 508
 Ecole des Mines, 55
 Edgerton, Fay, 37
 Eights, James, 55, 56, 101
 Emerson, Benjamin K., 258, 541, 549
 Emerson, George B., 22, 23, 122,
 127, 132, 136, 139
 Emmons, Ebenezer, 30, 40, 42, 53,
 57, 99, 206
 Emmons, Ebenezer, jr., 101, 315
 Emmons's Manual of Mineralogy and
 Geology, 30
 Emory's Survey of the Mexican
 Boundary, 274, 300
 Engelmann, George, 246, 247
 Eniskillen, Lord, 348
 Erian, 158
 Erie Division, 97
 Erie Canal, 51
 Erie Canal, geological survey of, 27
 Etheridge, Robert, 431
 European geologists in America, 104
 Evans, John, 245, 246, 435
 Everett, Edward, 320
 Everett, Thomas T., 144
 Evolution, 508
 Evolution of the North American
 Continent, 424
 Experiments, Henry's on electro-
 magnetism, 259
 Expert testimony, 212
 Exploring expedition, Fremont's, 174

F

Fairchild, H. L., 539
 Falconer, H., 347
 Fanning's voyage to the Antarctic,
 1828, 56
 Featherstonough, George W., 29, 54,
 106
 Fenton, Gov. Reuben E., 384
 Field, Cyrus W., 394
 Field, Henry M., 394
 Fillmore, Millard, 320
 Finger Lakes, 67, 72
 Finley, John H., 402
 First District, 52
 First Parish Meeting House, Hing-
 ham, 13
 Fitton, W. H., 433
 Five Points Mission, New York, 32
 Flower, Gov. Roswell P., 530
 Ford, S. W., 457
 Forty-niners, 181
 Fossils, abundance of in Fourth Dis-
 trict, 64
 Foster Geological Chart, 204-208
 Foster, James T., 205, 206
 Foster, John W., 209, 218, 224, 228,
 256
 Foster suit, 209
 Foster and Whitney Survey, 219, 224
 Fourth District, 53, 63, 68
 Frazer, Persifor, 423
 Frech, F., 538, 539
 Fremont, J. C., 174, 396
 French libel, 532
 French resentment of libel, 533
 French Revolution, 1848, 165-168
 Fritz-Gaertner, R., 412

G

Gabb, William M., 424
 Gannett, H., 539
 Gaspé, 302, 303, 370, 422
 Gaudry, Albert, 514, 544
 Gay, Martin, 21, 22
 Gebhard, John, 40, 41
 Gebhard, John, jr., 40, 41, 55, 135,
 382
 Geikie, Archibald, 402, 429
 Geikie, James, on mountains, 333-
 335
 Geinitz, H. B., 444, 534
 General Land Office, 145
 Genesee country, 65
 Genesee tablet, 71
 Genesee valley, description of, 70
 Geneva College, 152
 Geographical distribution of animals,
 187
 Geological chart, Hall's, 214
 Geological and Agricultural Hall, 133
 Geological Districts readjusted, 60
 Geological Divisions of the State, 58
 Geological experiences in the Bad
 Lands, 250

- Geological Hall, 318, 382
 Geological History of the North American Continent, 325
 Geological Map of the Middle and Western States, 94
 Geological Map of New York, 519, 535
 Geological Map of the United States, 404-406
 Geological Society of America, 42, 521
 Geological Society of France, 164
 Geological Survey of New York, 48
 Geological Survey of the vicinity of the Erie Canal, 27
 Geological Survey of Canada, 301
 Geological Survey of Iowa, 271, 357
 Geological Survey of New Mexico, 300
 Geological time in the courts, 213
 Geology of Canada, 304
 Geology in Mississippi, 175
 Geology, Monthly American Journal of, 29
 "Geology of North America," Marcou, J., 351
 Geology in Rensselaer School, 26
 Georgia, agricultural and geological survey of, 132
 Georgia trilobites, 369, 371-374
 Gibbs, Wolcott, 86, 200, 218
 Gilbert, G. K., 345, 387, 549
 Gill, Theodore, 423, 539
 Gillis, Lieut., 181
 Goadby, Henry, 198
 Goode, G. Brown, 142
 Gorham, Nathaniel, 64, 65, 73
 Gould, Augustus A., 23, 82, 122, 123, 132, 136, 231, 365, 388
 Gould, B. A., 202, 349
 Gould, Kendall and Lincoln, 128
 Graptolites, 304, 379-381
 Gray, Asa, 31, 37
 Gray, Francis C., 146
 Greeley, Horace, 271
 Greene, James S., 144
 Greenough, G. B., 106, 433
 Gregorio, A., 505
 Grimes, Gov. James W., 271-275, 279-281, 357
 Guyot, Arnold, 169, 221
- H**
- Hadley, James, 37, 40
 Hafner, Ludwig, 298
 Hagar, A. D., 454
 Haldeman, 135, 140, 238
 Hale, Benjamin, 151
 Hale, T. J., 361
 Hall at 75, 501
 Hall, Edward, 395
 Hall, James, birth, 13
 Hall, Chief Geologist, 62
 Hall, James, jr., 29
 Hall, James, sr., 11-12
 Hall, Mrs. James, sr., 14, 127, 180
 Hall, James W., 412
 Hall, Josephine, 395
 "Hall and Slade," 88, 89
 Hall, William, 88
 Hall's influence on science, 549
 Hall's "Text-book," 128
 Hall's tribute to Eaton, 37
 Hamilton, Alexander, 26
 Hanks, Henry, 481
 Hapgood, Henry, 12
 Harper, Lewis, 298
 Harpers, 128
 Harrington, B. J., 302, 379
 Harris, Hamilton, 530
 Harris, Ira, 192
 Hartt, Chas. Fred., 418, 425
 Harvard Address, 190
 Harvey, Gov., 360
 Haug, E., on mountain structure, 335, 336
 Hawkins, B. W., 432
 Hawley, Gideon, 319
 Hawn, Frederick, 341, 344
 Hayden, Ferdinand V., 244, 341, 346, 472
 Hébert, 438, 445, 480, 516
 Heer, O., 435
 Helderberg Division, 97
 Helderberg Mountains, 39
 Helderberg Mountains, distinguished visitors to, 113
 Helderbergs, survey of, 27
 "Helderberg War," 114
 Henry, Joseph, 27, 36, 181, 209, 215, 225, 258, 327, 350, 487
 Henry's experiments in Albany, 36
 Herzer, Henry, 418
 "Hibernicus," 51
 Hilgard, E. W., 299
 Hill, Nicholas, jr., 192, 208
 "Hills of Hingham," 11
 Hingham burying ground, 13
 Hingham, its surroundings and settlement, 10
 Hitchcock, C. H., 454
 Hitchcock, Edward, 28, 52, 100, 140, 173, 256, 321, 362, 375
 Hobart College, 151
 Hobart, Peter, 9
 Hobart, Rebecca, 9
 Hodge, James T., 145, 149
 Holder, Charles F., 423
 Holl, H. B., 432
 Holland Land Company, 66
 Holland Purchase, 66
 Holmes, W. H., 539
 Holst, 539
 Honors, List of, 552
 Hopkins, William, 347, 433
 Hornaday, W. T., 346
 Hornby, John, 66
 Hornby Lodge, 71
 Horsford, Eben N., 26, 30, 57, 68-72, 209
 Horton, William, 40

Hough, Franklin B. 384
 Houghton, Douglas, 30, 31, 33, 139, 148
 Houston, Gov. Sam, 396
 Hovey, E. O., 295, 549
 Hovey, H. C., 295
 Howard, Leland O., 419
 Howe, John A., 229
 Howell, E. W. 345
 Hubbard, B., 86
 Hubbard, Lucius L., 145
 Hudson Bay Fur Company, 246
 Hughes, McK., 539
 Hulke, J. W., 436
 Humboldt, von, 169, 452
 Hun, Thomas, 35, 213, 319
 Hungerford, Edward, 275
 Hunt, T. S., 305, 448-450, 454
 Hunt, Gov. Washington, 320
 Husted, James W., 466, 467
 Huxley, T. H., 348, 431, 435, 478
 "Hydrarchos sillimani," 89

I

Illinois Geological Survey, 282
 "Illustrations of Devonian Fossils," 474
 Indian Ladder, 113, 114
 Influence on Science, Hall's, 549
 Ingersoll, Ernest, 423
 Ingham, W. A., 457
 Inscription on Emmons's house, 102
 International Geological Congress, organization, 478, 480
 International Geological Congress at Washington, 538
 Iowa University, Department of Natural History, 282
 Iowa Geological Survey, 276
 Iowa State University, 273, 281
 Iowa State University, Chancellorship of, 273
 Iron fields of New York, 60
 Isle Royale, 145, 221
 Ives, Lieut. J. C., 298

J

Jackson, Charles T., 21, 132, 139, 173, 217
 "James Hall's Law," 336
 Jeffreys, J. G., 434
 Jewett, Ezekiel, 38, 73, 241, 339, 354, 383, 421
 John Boyd Thacher Park, 114
 John O'Groat's house, 71
 Johnson, Alexander S., 385
 Johnstown flood, 79
 Jones, T. R., 348, 432, 447
 Journey to Russia, 542
 Judd, J. W., 435

K

Kayser, E., 538, 539
 Kelly, John, 511
 Kellogg, Ebenezer, 38

Kellogg, G. M., 295, 363
 Kemp, James F., 536, 537
 Kendall, Charles S., 18-20
 Kentucky, State Geologist of, 181
 Kerr, W. C., 487
 Kew Gardens, 291
 Keyserling, 154
 Kidd, James, 192
 Kidnapping of William Morgan, 270
 Kimball, J. P., 457
 King, Clarence, 331, 424, 472
 King, T. Butler, 181
 King, Rufus H., 192
 Kingsley, J. S., 419
 Kirkdale caverns, 40
 Kirkwood, Samuel I., 357
 Kitchell, William, 296
 Koch, Dr., 88, 89
 Kunz, G. F., 465

L

Lake Bouvé, 21
 Lake Superior Copper Co., 144
 Lake Superior, expedition to, 146
 Lake Superior geology, 220
 Lake Superior Mineral Lands, survey of, 199, 217
 Lane, Alfred C., 145
 Langton, John, 308
 Lansing, Christopher Y., 192
 Lansing, Gerrit Y., 319
 Lansing, John, jr., 27
 Lapham, Increase A., 286, 289, 290, 293, 361
 Later geology, 535
 Law of 1893, 530
 Lawrence, Amos, jr., 229
 Lawrence Scientific School, 187
 Lea, Isaac, 523
 Leavenworth, E. W., 266, 383
 LeConte, John L., 238
 LeConte, Joseph, 225, 541
 Lecturer at Cornell University, 423
 Lectures by Hall, 43
 Legislative resolution to Hall, 532
 Leidy, Joseph, 245, 296
 Lesley, J. P., 277, 278, 455-459, 481, 514-518, 534
 Lesquereux, Leo, 221
 Lesueur, 89
 Letchworth Park, 71
 Lewis, Dr. Dio, 365
 Lewis, Tayler, 263
 Liberian Colonization Society, 242
 Liebig, 74, 319
 Lincklaen, Ledyard, 179, 339, 383
 Lincoln, Major-General Benjamin, 12
 Lindström, G., 547
 Linnean Society, 22
 Lintner, Joseph A., 386
 Litton, 228, 297
 Liverpool Free Museum, 394
 Livingston, James Duane, 106
 Locke, John, 87, 218
 "Lockport Company," 87
 Logan Club, 305

Logan Memorial, 305
 Logan, W. E., 302-304, 307, 321, 376
 Lohest, M., 539
 London associates, 66
 Lord, Jarvis, 461
 Louis Philippe, 165
 Lovering, Joseph, 195
 Lowe, Gov., 279, 281, 357
 Lowell Institute, 86, 118, 168
 Lowell, John A., 122, 123, 188
 Lowell, James Russell, 424
 "Lower strata," 138
 Lucas, F. A., 346
 Lundholm, 539
 Luther, D. Dana, 535, 537
 Lydia street, Hall's home on, 150
 Lyell, Lady, 170
 Lyell, Sir Charles, 39, 78, 98, 107, 136, 148, 257, 347, 433, 436; travels through the States, 116; visits Hall, 109; "Travels in North America," 127; "intrusion," 122; second visit, 149; third visit, 257; travels, 112, 129
 Lyman, Benjamin Smith, 278, 279
 Lyon, Lucius A., 31, 33
 Lyon, Sidney S., 243

M

McChesney, J. H., 283, 285, 295
 McCoy, F., 438
 McGee, W. J., 520, 539, 540
 McInnes, William, 305
 Macbride, Thomas H., 281, 282
 Macclure, William, 89, 106
 Mahan, Dennis H., 194
 Maine, Geological Survey of, 217, 454
 Manual of Geology, Emmons, 128
 March, Dr. Alden, 133
 Marcou, Jules, 219, 351
 Marcy, Gov. William L., 52, 62, 296, 530
 Marcy's survey of the Red River country, 300
 Margerie, E. de, 516, 539
 Markoe, Francis, 144
 Marsh, Dexter, 87
 Marsh, O. C., 87, 443, 497, 519, 539
 Maryland, University of, 43
 Massachusetts, Geological Survey of, 52
 Massachusetts' New York lands, 65
 Mason, Daniel, 9
 Mason, John, 9
 Mastodon from Cohoes, 386
 Mather, W. W., 40, 53, 100, 206
 Maude, traveler and explorer, 64
 Mauvaises Terres, 245, 248
 Meek, Fielding B., 243, 246, 251, 280, 341
 Memorial inscription, A. A. A. S., 102
 Memorial tablet on "office," 237
 Meneghini, Joseph, 505

Merrill, F. J. H., 520
 Merrill, George P., 177, 218, 257, 368
 Mexican Boundary Survey, Emory's, 274
 Mexican War, 73
 Michigan Territory, 144
 Miller, Hugh, 40, 41, 338
 Mining projects, 261
 Mississippi geology, 175, 177, 298
 Missouri Geological Survey, 297
 "Missourium," 88
 Mitchell, Ormsby M., 194
 Mohawk Division, 97, 157
 Monteith, James, 73
 Monthly American Journal of Geology, 106
 Montreal Address, 323
 Moore, Zephaniah Swift, 38
 Morgan expeditions, 426
 Morgan, Lewis H., 390, 391, 441
 Morgan, William, 270
 Morris, John, 434
 Morris, Robert, 65
 Morse, Edward S., 400, 420, 498
 Morse, S. F. B., 36, 217, 258, 487
 Morton, Henry, 440
 Morton, Samuel G., 88, 140, 151
 Mountain structure, 325, 326, 331-333
 Mount Sylvan Academy, Miss., 176
 Murchison, Sir Roderick, 80, 98, 106, 153, 156, 158-162, 348, 393, 433, 468
 Murdock, Hiram, 87
 Murphy, Edward, 511
 Murray, David, 496, 529, 547
 Museum of Comparative Zoology, 384
 Museum of Scientific and Practical Geology and General Natural History, 385

N

Naples, 73
 National Academy of Sciences, 518
 National Academy of Sciences, Albany meeting, 1885, 498
 National Geological Museum, 188
 National Institution, 140, 142
 National Research Council, 345
 National University, 202
 Natural History Survey of New York, 48
 "Nestor of American Geologists," 539
 Newberry, Henry, 95
 Newberry, John S., 39, 87, 95, 96, 244, 274, 288, 297, 396, 467
 New Hampshire Geological Survey of, 217
 New Harmony, 89, 227
 New Jersey Geological Survey, 296
 Newland, John, 208
 New York City Lyceum of Natural History, 57

New York Legislature, 532
 New York State Museum, 27, 36
 New York Series of Geological
 Formations, 525, 550
 New York "Tabernacle," 120
 New York Tribune, 120
 Niagara Falls, Lyell and Hall at, 111
 Nicholson, H. A., 469, 470
 Nicollett, 130
 Niles, W. H., 549
 "North California," 174
 "North Country," 179
 Northern Transcontinental Survey,
 398
 Norton, John P., 194
 Norwood, J. G., 283, 285
 Novak, O., 479

O

Oehlert, D-P., 533
 "Office" on Beaver Kill, 236
 Ohio Geological Survey, 297
 Olcott, Thomas W., 179, 190, 192,
 202, 319
 "Old Bank Building," Troy, 47 -
 "Old Capitol," 133
 Old Red Sandstone, 39, 79, 420
 Old Ship Church, Hingham, 13
 "Old State Hall," 318
 Oneonta sandstone, 422
 Ontario Division, 97, 157
 Organization of Natural History
 Survey, 51
 Orton, Edward, 401, 537
 Owen, David Dale, 89, 94, 139
 Owen, Richard, 89
 Owen, Robert, 89

P

Pacific Railroad Survey, 246, 299
 Packer, Asa, 419, 457
 Palaeozoica, 305
 Palmer, E. D., 440
 Parallelism of American Formations,
 226
 Parker, Amasa J., 190, 192, 209,
 319, 539
 Parker, W. K., 432
 Parry, C. C., 274, 275
 Patch, Sam, 67
 Patroon of Albany, 25
 Peabody Academy, 419
 Peale, Rubens, 40
 Peck, Charles H., 385, 391
 Peirce, Benjamin, 194, 195, 230
 Penekese School, 463
 Pennsylvania Geological Survey, 456
 Percival, James G., 287, 288
 Permian discussions, 341-344
 Petrified forests, 460
 Phelps, Oliver, 65
 Phelps and Gorham Purchase, 65, 66
 Phillips, John, 434
 "Poems" by Mrs. Hall, to Lady
 Lyell, 127

Poinsett, Joel R., 142, 143
 Polytechnic School in New York,
 200, 203
 Pope's Survey of Texas, 300
 Portage cataracts, 71
 Potter, Bishop, 134, 201, 320
 Powell, John W., 75, 415, 474, 539
 Pulteney, Sir William, 66
 Pumpelly, Raphael, 383, 398, 412,
 455, 498, 539
 Putnam, F. W., 400
 Preemption line, 65
 Preface, 7
 Prentice, Ezra P., 190, 319
 Prestwich, Joseph, 434, 437
 Price, Rodman W., 296
 Primordial fauna, 99
 Prosser, Charles S., 520, 537
 Prout, H. A., 297
 Pruyn, John V. L., 319, 384, 441
 Pruyn, Robert H., 192

Q

Quebec Group, 368-379, 448, 450,
 451

R

Ramsay, A. C., 312, 342, 347, 348,
 421, 431, 436, 468, 482, 483
 Randall, Gov., 292
 Randall, Henry S., 164, 179, 232
 Randall, S. S., 196, 204, 215
 Rathbun, Richard, 142, 412, 539
 Raymond, Henry J., 120
 Redfield, 140
 Regents of the University, 27, 50,
 381, 384, 391, 496, 529, 530, 532
 "Regents Reports," 390
 Reid, Stephen, 256
 Reid, Whitelaw, 439
 Rensselaer County, Geological Sur-
 vey of, 27
 Rensselaer Polytechnic Institute, 28,
 45
 Rensselaer School, 24-26, 28, 29, 34,
 39, 88
 Rensselaerean Plan, 25
 Reusch, 539
 Rhode Island, Geological Survey of,
 217
 Rice, Victor M., 385
 Ries, H., 537
 Rochester, University of, 269
 Roemer, Ferdinand, 172, 445, 472
 Rogers, Henry D., 53, 59, 74, 76,
 100, 135, 144, 148, 256, 296, 348
 Rogers, William B., 53, 59, 90, 91,
 100, 256
 Rominger, Carl, 397, 453, 522
 Roosevelt, Theodore, 466
 Root, Elihu, 151
 Root, Oren, 151, 384
 Rothpletz, 539
 Ruedemann, R., 370, 381

Rumels, Gov., 298
 Rumford, professor of chemistry, 57
 Rush Medical College, 56
 Russia, journey to, 542, 544
 Rust, W., 461

S

Safford, 396
 Sager, Abram, 30, 31, 45, 86
 Salter, J. W., 430
 Salutation from International Congress, 539
 Sanders, William S., 32
 Sao Paulo, Geological Survey of, 426
 Sarle, C. J., 537
 Sartwell, 150
 Say, 89
 Schoepf, 105
 Schoolcraft's Expeditions, 33
 School days at Hingham, 15-21
 Schmidt, A., 412
 Schmidt, C., 539
 Schmidt, F., 538, 539
 Schuchert, Charles, 39, 99, 158, 335, 526-528, 534
 Science in the courts, 212
 Scott, Gen. Winfield, 73, 241
 Scrope, G. P., 436
 Second District, 53
 Sedgwick, 98, 106, 154, 393
 Seneca Indians, 64
 Seventh International Congress, 542
 Seward, Gov. William H., 271
 Seymour, Gov. Horatio, 383
 Seymour, John, 383
 Sharp, Dallas Lore, 11
 Sharpe, Daniel, 433
 Shays's Rebellion, 12
 Shepard, C. U., 86, 145
 Sherwood, Andrew, 421, 457
 Sherwood, Clark, 421
 Shumard, Benjamin F., 246, 298, 342, 396
 Shumard, G. C., 298
 Silliman, Benjamin, 26, 29, 45, 53, 86, 89, 123, 136, 375
 Silliman, Benjamin, Jr., 123
 "Silver-Grays," 271
 Simpson, George B., 407, 408, 522
 "Six Days of Creation," 264
 Sixtieth Anniversary, 540
 Slade, Israel, 88, 89
 Smith, Goldwin, 424
 Smith, Herbert H., 418, 426
 Smith, Increase N., influence on Hall, 16, 17
 Smith, William, 40, 41
 Smithson, James, 143
 Smithson bequest, 142
 Smithsonian Institution, 27, 234
 Smock, John C., 496, 537
 Smyth, C. H., Jr., 536, 537
 Society for the Diffusion of Useful Knowledge, 160
 Society for the Promotion of Agriculture, 49

Society of St. Petersburg, Imperial Mineralogical, 92
 Sorby, 347
 "Species-making," 494
 Speculations in mineral lands, 90
 Spinner, F. E., 344, 511, 512
 Springer, Frank, 353, 471
 Stainier, 539
 Starr, Frederick, 470
 State Cabinet of Natural History, 381
 State Geologist of Iowa, White, 359
 State Geologist of Kentucky, 181
 State Geologist of Michigan, 452
 "State Hall," 133, 499, 500
 Steenstrup, 400
 Stefanescu, 539
 Stevenson, John J., 42, 95, 458, 521
 Stokes, Charles, 437
 Stone, William M., 359
 Storer, D. Humphrey, 23, 230
 Storrs, Abel, 32, 35
 "Strata" Smith, 40
 Streng, 539
 St. John, Orestes, 298
 St. Louis Academy of Science, 247
 St. Petersburg Congress, 542
 Successive introduction of species in geological times, 187
 Suess, E., 335
 Sullivant, 222
 Surveys of Albany and Rensselaer Counties, 27
 Survey of the Helderbergs and Catskills, 27
 Swallow, G. C., 228, 252, 297, 343, 396, 454, 470
 Swinton, 407
 Swiss Emigrés, 221.

T

Taconic Mountains, 119
 Taconic question, 52, 57
 Taconic System, 99, 120, 135, 150, 206, 212, 315, 374
 Taylor, John W., 382
 Taylor, Richard C., 79
 Temple Hill School, Geneseo, 74
 Texas Geology, 298
 Texas Geological Survey, 396
 Text-book on Geology, Dana, 215, 310
 Thayer, Nathaniel, 425
 "The Recession of Niagara Falls," 120
 "The Zodiac," 56
 Theory of mountain structure, 327-330
 Thieme, Otto, 352
 Third District, 53
 Thomas, David, 234
 Thomas, J. J., 384
 Ticknor, 123
 Tocqueville, de, 67
 Toland Medical College, 56
 Torrell, 479

Torrey, John, 124
 Townsend, Martin I., 530
 Trask, John B., 299
 "Travels in North America," Lyell, 127
 Trilobites, Devonian, 523
 Trip down the Ohio river, 94
 Trip to Sweden, 1897, 544
 Troost, Gerard, 89, 233
 Troy Lyceum, 26, 89
 Tschernyschew, 539
 Tucker, Luther, 175, 190-192
 Tuomey, Michael, 30, 177
 Tyndall, J., 435

U

Ulrich, E. O., 526
 Union College, 203, 263
 United States Exploring Expedition to California, 181
 United States Military Academy, 53
 United States Sanitary Commission, 96, 396
 "Unity of races," 229
 University of Albany, 56, 192, 193, 195, 197, 198, 240
 University of California, 57
 University of Maryland, 43
 University of Michigan, Medical School, 31
 University of Wisconsin, 56
 Upson, Anson J., 532
 Utica Free Academy, 37

V

Van Benthuyzen's Sons, C., 410
 Van Buren, Martin, 296
 Van Deloo, Christian, 294, 412
 Van Deloo, Jacob, 502, 548
 Van Rensselaer, Alexander, 32, 47
 Van Rensselaer, Stephen, 25, 27, 29, 50, 54, 57, 107, 319
 Van Rensselaer Manor, 319
 Vanuxem, Lardner, 53, 55
 Vaux, Calvert, 235
 "Vegetable fossils," 42
 Verneuil, de, 83, 153, 154, 164, 279, 485
 Vermont University, 275
 "Vestiges of Creation," 437
 Villages of the Fourth District, 66

W

Wabash College, 295
 Wachsmuth, Charles, 353, 471
 Wadsworth, James, 146, 345
 Wahnschaffe, 539
 Walcott, Charles D., 370, 413-415, 461, 473, 474, 539
 Walker, Sir Edmund, 471
 Walker prize, 519

Walworth, C., 320
 Ward, Henry A., 345, 387, 441
 Ward, L. F., 539
 Warde, John A., 243
 Washington meeting, international Geological Congress, 538
 Webster, John W., 74, 229
 Websters and Skinners, 208
 Weed, Thurlow, 243, 271, 319
 West Point Military Academy, 323
 Wesleyan University, 53
 Wheatley, C. M., 87
 Whipple's Survey of the 25th Parallel, 300
 Whitfield, R. P., 280, 355, 408
 Whitney, Josiah D., 199, 201, 209, 218, 273, 289, 361
 Whitney, William D., 362
 White, Charles A., 294, 357, 358, 539
 Whittaker, William, 431
 Whittlesey, Charles, 220, 221, 289
 Wild, Alfred, 387
 Wiley & Putnam, 124, 128
 Wilkes Exploring Expedition, 140
 Williams College, 54
 Williams, George H., 37
 Williams, Mrs. George H., 462
 Williams, Henry S., 512
 Williams, Robert S., 37
 Williams Samuel G., 419
 Williams, Samuel Wells, 32, 35, 37, 45
 Williams, Watson, 37
 Williamson's Survey of California, 300
 Wilson, Alexander, 64
 Winchell, Alexander, 384, 418, 451, 521
 Winchell, N. H., 528
 Wisconsin College at Appleton, 229
 Wisconsin Geological Survey, 286, 360
 Wollaston, W. H., 433
 Wood, Daniel P., 462, 467
 Woodrow, James, 344
 Woodworth, J. B., 21, 218
 Woolworth, S. B., 384, 441
 Worthen, A. H., 243, 275, 282
 Wright, Benjamin H., 194
 Wright, John, 26, 30, 32, 69
 Wright, Silas, 137, 138
 Wyman, Jeffries, 144, 152, 195

Y

Yale College, 45, 86
 Yale College, laboratory, 45
 Yale College, lectures at, 45
 Yale College, president of, 37
 Young, Samuel, 134
 Younglove, T. G., 386

Z

Zeisberger, 75
 Zittel, von, 539

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